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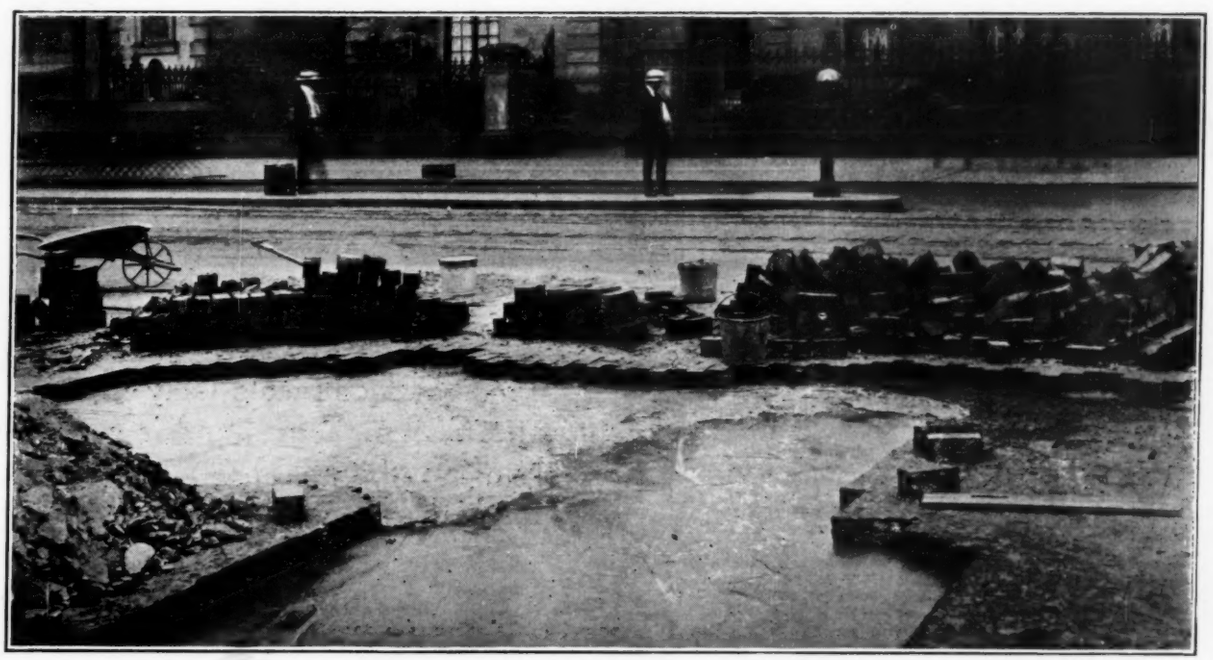

REPAIRING SAND-CEMENT CUSHION OF WOOD BLOCK PAVEMENT, BROAD STREET, NEWARK, N. J.

Wet mortar has been applied to old concrete base, ready for asphalt flush coat. The reason for and methods of making these repairs are described in this issue.

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Paving Materials in Various Counties
Designing Improvements in Toledo's Sewerage
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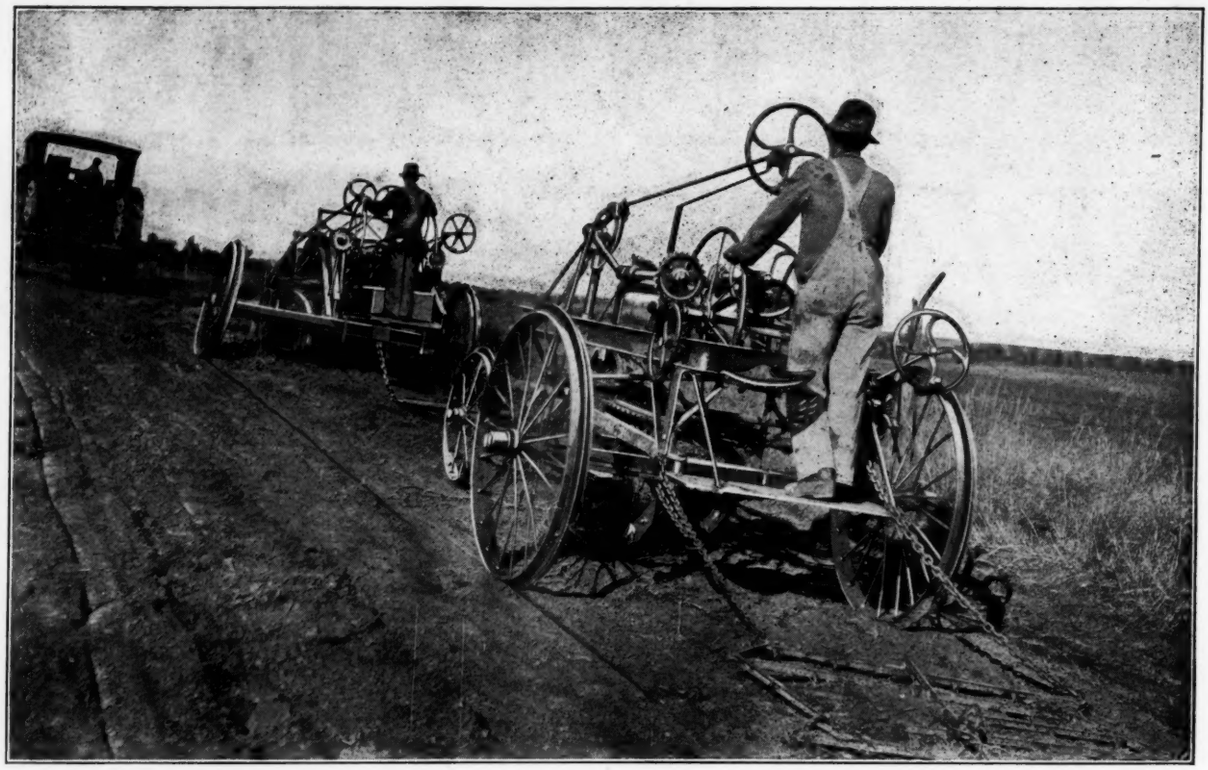

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Vol. 50 **JUNE 18, 1921** **No. 25**

Repairs to Wood Block Pavement in Newark

By William A. Howell*

These repairs were made necessary by the local destruction of the sand-cement cushion near street railway tracks. In making the repairs, the old base was covered with a wet mortar surface painted with asphalt. A high percentage of the blocks were suitable for relaying after seven years' service

The wood block pavement on Broad street, Newark, N. J., completed on October 1, 1914, having a length of nearly two miles and containing about 80,000 square yards of wood block, one of the most successful wood block pavements ever laid in this country, considering the tremendous traffic it has carried, has again assumed prominence on account of the need of repairs at various points along the line of the pavement. The pavement was originally laid on an 8-inch concrete foundation, with a 1-inch mortar cushion consisting of one part portland cement and 4 parts of sharp sand. The pavement immediately preceding the wood block pavement was a granite pavement on a sand foundation, laid in sections at various intervals from 1879 to 1886. The street railway tracks were laid to accommodate a crown suitable for a granite pavement and therefore required considerable adjustment in order to make the crown as flat as possible to fit in with a wood

*Engineer in charge, Bureau of Paving, Newark, N. J. Member Am. Soc. C. E., A. A. E. and A. S. M. I.

REPAIRED PAVEMENT, BROAD STREET AT N. W. CORNER OF CENTRAL AVENUE
Space repaved, 40 by 10 feet. Photographed June 1, 1921

block pavement. This pavement was described in "Municipal Journal" for October 29, 1914.

The wood blocks were partly manufactured at Mobile, Ala., at the plant of the Republic Creosoting Company, of Indianapolis, Ind., and partly at the local Newark plant of the American Creosoting Company. A very successful expansion joint one and one half inches wide was poured along the curbs and has given great satisfaction.

The blocks were soaked in tubs containing water for ten minutes before laying. The specific gravity of the preservative used ranged from 1.07 to 1.13 and the blocks thus treated weighed 18 pounds to the cubic foot. The blocks furnished by the Republic Creosoting Company were approximately 4 inches wide and 4 inches deep and were laid from South street to Bank street, at the southern end of the work. The blocks from the local plant of the American Creosoting Company were 3 inches wide and 4 inches deep, and were laid on the northerly part of the street, or from Bank street to Belleville avenue. The longitudinal curb grades on Broad street were exceedingly favorable for the laying of a wood block pavement. Not more than 5 per cent of the total yardage was laid on a grade exceeding 2 per cent. More than one-half of the entire yardage was laid on grades not exceeding one-half of 1 per cent. Especial attention was given by the writer to perfect the surface drainage of the street throughout its entire length. More than sixty feet of the old-time wing corner basins were rebuilt, and enlarged, and at least twenty-five new side basins were installed, some at great expense, as the connections had to be laid completely across Broad street. The paving work was not only carefully inspected by veteran city inspectors, carefully selected, but special inspectors employed by the Property Owners' Association were also detailed to watch the construction of the pavement. The preservative did not ooze out of the blocks and give annoyance to the traveling public. On hot days when the preservative was in evidence on the street, the pavement was carefully sanded by the Street Cleaning Bureau and although the residents of Newark are quick to resent any real or imaginary wrongs by rushing to the newspapers, the writer does not recall a single complaint that was registered at the City Hall or in the newspapers of the condition of the pavement during the first three or four years of its history.

CAUSE OF DETERIORATION

No considerable area of the pavement expanded so as to produce trouble. There was a slight expansion near the safety isle at the northwest corner of Broad and Market streets, but it was only local, and after proper repairs had been completed never gave any additional trouble.

The street railway tracks on Broad street, at the time of the construction of the new wood block pavement in 1914, were not reconstructed in a manner to harmonize with the new roadway construction. From the point of view of the street railway company, its representatives did all they thought necessary to put their tracks and track pavement in good condition, but from the point of view of the city, the work of the street railway company was lacking in one important essential, in that the tracks were not made water-tight and waterproof. From Market street to Clinton avenue the Public Service Railway Company in 1914 made no repairs whatever to their Broad street tracks immediately preceding the construction of the new wood block pavement.

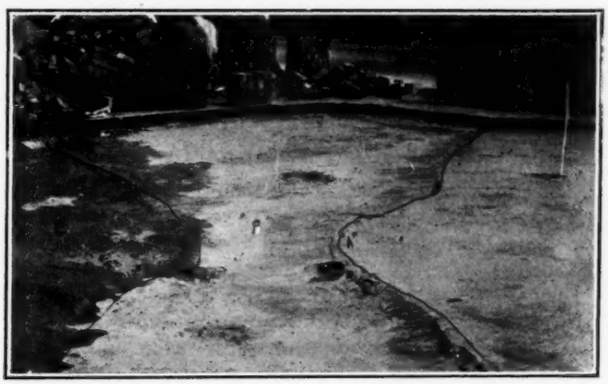
It is true that in 1909 the street railway company had laid one of the most carefully constructed track pavements ever laid in the country on Broad street from Market street to Clinton avenue. In 1914 the company assumed that the tracks and the track pavement needed no additional repairs. This assumption was not correct. The heavy car traffic going over these tracks in five years had caused considerable wear and tear on the ties and consequently a spring of the rails at the joints. In 1909 the track pavement was water-tight, in 1914 it was not.

Within a few months after the completion of the new wood block pavement, the blocks commenced to heave up and buckle in many places immediately adjoining the tracks between Market street and Clinton Avenue. The joints were filled with cement grout to make them waterproof after the Public Service Railway men had tamped the ties, and it was hoped that the trouble had been mastered.

The upward and downward heave or vibration of the rails and ties continued to give trouble, and in time the trouble, instead of being confined to close proximity to the rails, extended from 5 feet to 15 feet from the track. Water got in the track, under the ties, and overflowing got under the blocks and gradually caused the disintegration of the cushion. In some cases the cushion was washed out entirely from under the blocks, and in other instances the original one-inch cushion was increased to 2 or 3 inches, and a depression was thus caused in one place and a corresponding hump in the pavement immediately adjacent.

All of this damage from water was still further increased by the weight of the abnormally heavy war traffic passing over the street during the years 1917, 1918 and 1919. What held good for the condition of the wood block pavement between Market street and Clinton avenue, where the width of the roadway was about 38 feet on either side of the street railway tracks, applied most particularly to that portion of the street north of Market street, where the width of each roadway, especially between Belleville avenue and Bridge street, was not more than 20 feet. On this northerly part of the street repairs had been made by the street railway company in an endeavor to put their tracks in good condition prior to the construction of the wood block pavement, but the repairs, however extensive, were not made as carefully and thoroughly as on that portion of the street south of Market street in 1909. The situation as it exists today is that the pavement is in a bad condition where the track pavement is loose, and in good condition where the track pavement is good.

The wood block pavement is in its worst state of repair at the northern end of the street be-



A—NEW LAYER OF SMOOTH CONCRETE. B—THE ORIGINAL CONCRETE BASE SWEPT OFF. C—DISCOLORATION CAUSED BY WATER AT CATCH BASIN.

tween Bridge street and Belleville avenue, where the roadway is only about half as wide as it is from Central avenue to South street. There are large areas of the Broad street wood block pavement where the pavement is practically in as good condition to-day as when originally laid. On the west side of the street railway tracks alongside of Washington Park, in front of the Prudential Life Insurance Company's building, and along the entire length of Lincoln Park, the pavement is still in almost perfect condition, hardly a block out of place. It is a safe assertion that where the tracks are water-tight the wood block pavement remains good.

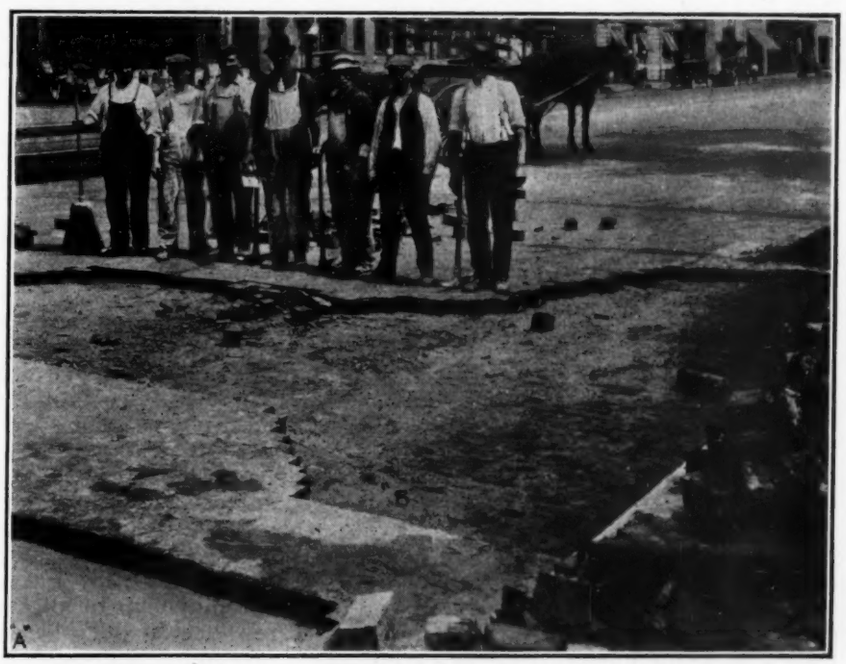
The repairs made by the contractor at the completion of the five-year guarantee period were not altogether satisfactory and the pavement was not finally accepted until 1920. In the repairs made, the contractor simply repeated the method adopted in laying the blocks originally, on a dry mortar cushion slightly dampened with water before the blocks were laid. That this method was not satisfactory soon became evident, the street railway tracks becoming more and more out of repair and the seepage from the rails under the wood blocks making more and more trouble with the cushion. It had been the intention of the writer to make very extensive repairs to the pavement in the fall of 1920, but the lack of funds of the bureau prevented the work from proceeding.

At the conventions of the American Society for Municipal Improvements held at New Orleans in 1919 and at St. Louis in 1920, Supervising Engineer James W. Costello and the writer consulted the most eminent authorities on up-to-date wood block paving in the country, and acting on their advice we are making repairs to the street as follows:

The old mortar cushion, unless in good condition, is scraped off the concrete base. A rich wet mortar strip, very smooth, at least one inch thick, is laid on top of the concrete base and allowed to harden. This strip is composed of one part cement to two of sand. The concrete strip is allowed to harden for at least 3 days, and then is painted with hot asphalt cement having a depth ranging from ⅛ to ¼ of an inch. This coating is allowed to cool, and then the wood blocks are laid thereon, as many of the original blocks being retained as their state of wear will permit. After the blocks have been laid and carefully tamped, hot asphaltic cement is poured in the joints, the pavement is sanded and allowed to stand for at least one day before traffic is allowed to pass over it. This method of reconstruction seems to have handled the situation successfully to date.

The wood block pavement has been repaired from Belleville avenue to Central avenue west of the street railway tracks and has been very much improved in appearance. Repairs recently made to the wood block immediately adjacent to the rails do not last any great length of time, owing to the need of tamping the ties. It is only fair to state that the financial condition of the Public Service Railway Company is common to most street railway companies in the United States at this time. Wages and materials have advanced more sharply than the railway receipts. Public utility commissions have, in many instances, particularly in this state, declined to authorize an increase in fare. In addition to this fact, in the city of Newark the street railroad company has had fierce competition from the jitney buses, which carried 45,000,000 passengers in this city during 1920, diverting over $3,000,000 from the receipts of the street railway company.

In spite of this experience, it would not be correct to say that the mortar cushion laid dry with



A—COMPLETED SMOOTH FINISHED CONCRETE LAYER COURSE. B—REMOVING THE OLD MORTAR CUSHION. AREA OF REPAIR, ABOUT 200 SQUARE FEET.

one part portland cement and three or four parts sand is a failure under wood block pavement.

In the city of the writer, there are miles of wood block pavement in an excellent condition, laid with the mortar cushion. Mechanic street, Mt. Pleasant avenue, High street, Prince street, Roseville avenue, are all in fine condition. Some of these streets have been down nearly ten years. The only failure of the cushion has been on Broad street, caused by the condition of the street railway tracks, and on Passaic avenue caused by the lack of a storm water sewer. It is a safe statement to make that, had there been no street railway tracks on Broad street, the wood block pavement would have been in nearly as good condition as that on Roseville avenue or Mt. Pleasant avenue.

Up to June 10th about 150 depressions in the pavement had been repaired ranging in area from 3 or 4 square feet up to 500 square feet. We were greatly surprised at the large percentage of salvage of old blocks, in some cases running as high as 90 per cent. We started with 75,000 new wood blocks, half of them 3 inches and the other half 4 inches wide and we fully expected to use as many more new blocks before we had gone over the entire street. We have taken care of at least half of the worst depressions in addition to numerous small ones, and we have about 45 per cent. of the original number of our new blocks left.

We have rigidly adhered to our rule not to allow traffic over the newly-repaired spots within four days after the smooth concrete layer had been laid, even where the traffic is the heaviest. Of course we have had to obtain the co-operation of the police department in order to keep traffic away from our work.

We feel that we have made no mistake in using asphaltic cement of the proper penetration for both the paint coat and the filler. It may, and probably will, cost more than pitch in the end, but our experience with asphaltic cement for a year or more on wood block repairs has convinced us that, given a satisfactorv smooth concrete, asphalt will outwear pitch, at least on a street carrying such a heavy volume of motor truck traffic as does Broad Street, Newark. We hold no brief for the use of asphalt, but results are what we are after and we are firmly convinced that we are getting them.

Reservoir Roof for Recreation

A few weeks ago we described the construction of a reservoir at Arkansas City, Kan., the flat roof of which is to be used for tennis courts. This city has not a monopoly of this idea, it appears, for in its report for 1920 the Board of Water Commissioners of St. Paul, Minn., states that it expects to build a high-service reservoir, which will be built of reinforced concrete and covered, and the whole property, which consists of 40 acres of land, will then be turned over to the park department for park purposes. It is proposed to have a look-out tower on the reservoir, since an excellent view of the surrounding country can be had from this elevated position. "It is also thought that tennis or other athletic games can be played on top of the reservoir, since it will be quite large and very level."

Low Cost of Road Grading in Nebraska

In the April report of the Department of Public Works of Nebraska is given the following account of how that state obtained low prices for road grading:

In 1918 and 1919, our earthwork cost about 35 cents per yard. In 1920, we were paying an average of 58 cents. Even this high price was lower than surrounding states were paying, for answers received from a questionnaire brought in the following:

State	Price Per Cu. Yd.
Kansas	$ .69
Missouri	.75
Iowa	.66
Colorado	.817
Utah	.75
Nevada	.75
Michigan	.85
Illinois	.80
South Dakota	.80
Ohio	.648
Indiana	.94

It is of interest to compare our average bid price of 58 cents with the average bid price of 75 cents in other states. This meant a saving to the state of 17 cents per cubic yard and on the seven million cubic yards contracted for, made a saving of $1,190,000. This was possible only through careful planning. Early in the spring of 1920 we announced the work which was to be let. At the letting the contractors were very well represented. We had provided that the bids for the contracts which were to be awarded each day were to be filed on the morning of the same day. On opening the bids the first day, we found the average bid price to be about 65 cents per cubic yard. The bids were promptly rejected and the state took the contract at the estimated price, which was 50 cents. On the second day, the average bid was 58 cents, a saving of 7 cents on the yard.

Water Improvement for Washington, D. C.

Congress has appropriated $200,000 with which to begin operations on the construction of a new conduit for bringing water to Washington, D. C.

The present conduit is over 60 years old. As it is the only one bringing water to the city it has not been possible to empty it for repairs of any kind without shutting off the supply, which the authorities are willing to do only in an emergency. It is known that the conduit has deteriorated to a certain extent, but it is impossible to state how greatly until an examination can be made.

The appropriation is made "for the preparation of plans, the initiation of work including the employment of all necessary engineering, technical, clerical and other services." Sixty per cent of this sum will be paid from the revenues of the District of Columbia and 40 per cent from the treasury of the United States.

Designing Improvements in Toledo Sewers

These include intercepting sewers and pumping plants to discharge all the sewage below the city. The article describes at some length the method pursued by the engineers in studying conditions and planning the improvements; also some of the special features of the design itself.

For several years Toledo, Ohio, has had under way plans for improving its sewerage conditions, the investigations and designs having been made by the engineering firm of Fuller & McClintock, of New York. General plans and recommendations were submitted by this firm in 1919, detailed plans prepared, and bids asked in 1920. Contracts for two intercepting sewers were let in January and March. For 18,400 feet of 72 and 66-inch interceptor the contract price was $585,770. For 13,000 feet of 57 and 54-inch interceptor the contract price was $458,826. In June bids were asked on a pumping station and plant. Only a few bids were received, however, and none of these was considered acceptable, and bids were again received on February 15 of this year, when a contract was let for a part of the work. The estimated cost of the projected improvements complete is more than $4,000,000.

Owing to the interest just now in the matter of bids and prices, a comparison is given of those for the pumping station submitted on June 15, 1920, and February 15, 1921. On each of these occasions only one bid was received for the superstructure of the sewage pumping station, the total bid for this having been $127,872 in 1920 and $89,920 in 1921, a reduction of 30 per cent in 8 months. The only other contract bid upon on both occasions was for the sewage pumping equipment. Three bids were received on this in 1920 and 6 bids in 1921. The itemized bids, on some of the principal items of the low bidders on each of these occasions were as follows: Centrifugal motors and pumps, $66,000 and $63,186. Electric hoists for screens, $20,000 and $16,045. Electrically operated gate valves, $12,000 and $10,521. Switchboard, transformers, starters and wiring, $15,000 and $19,569 (an increase). Screens, $10,000 and $6,200. Main suction and discharge piping, $22,000 and $16,618. 36-inch meters, $17,000 and $13,625. Sluice gates, $13,000 and $8,288. The total of all items in the contract was $196,300 in 1920 and $169,182 in 1921, the former bid having been that of the Pitt Construction Company, of Pittsburgh, and the latter that of John R. Proctor Company, Inc., of New York City. The Pitt Construction Company also bid in February of this year, their latter bid being $9,500 lower than their former.

The work contemplated in improving the sewerage conditions of Toledo comprises intercepting sewers to prevent discharge of house sewage into the Maumee river and tributary streams in the city, and two pumping plants, one on each side of the river, to discharge into the river below the city the sewage collected by the interceptors. It may at some more or less distant date be necessary to treat the sewage before discharging it into the river, and while this possibility has been kept in view in preparing the design, it is not believed that treatment will be required for some years and no definite plans for it were made.

The general features referred to are by no means novel, being those found necessary in the majority of such cases, but there are several details that are of considerable interest, and in addition the careful canvass made of existing and anticipated conditions and the scientific analysis of the data so obtained were unusually complete and a brief presentation of their salient features will serve as an excellent illustration of how the study of a problem of this kind is conducted by engineers of the highest reputation.

EXISTING CONDITIONS

Toledo has an estimated population of 254,700, occupying a total area of 15,945 acres. The Maumee river divides it into two main parts known locally as East Toledo and West Toledo, the former having an estimated population of 43,180 and the latter one of 211,520. The topography of the city is such that all of East Toledo drains toward the river while in West Toledo there are three drainage areas, tributary to the river, to Swan creek and to Ten Mile creek, respectively. At present the city sewers, built on the combined plan, drain into these several streams. In times of dry weather the sewage discharged into the creeks produces stagnant pools that are a nuisance and menace to the health of the citizens.

The topography indicated the location of four intercepting sewers, three on the west side of the river and one on the east side. The sewers would concentrate the sewage from the entire city to two pumping plants on opposite sides of the river near the lower boundary of the city. The river here is quite wide and two plants seemed preferable to conducting the sewage from one side across the river to the other so as to operate only one pumping station. In addition, it seemed probable that it would not be necessary to construct the east side intercepting sewer for a number of years and therefore it would be undesirable to provide for east side sewage in estimating the capacity required for the west side pumping station and the outlet therefor. No nuisance is yet caused in the river itself by the sewage discharged into it, although there are evidences of sewage pollution; it therefore seems probable that, when the west side intercepting sewer has removed from the river all of the pollution now reaching it from that side, the effect of the east side pollution will be so comparatively slight as not to demand immediate and costly remedies.

GENERAL FEATURES OF DESIGN

The west side pumping station, known as Bay View Park pumping station, is the one for which bids were received as mentioned above. A river outlet with multiple discharge openings has been designed in connection with this station, but as its construction will probably require much less time than that of the pumping station and equipment, it was thought best not to attempt to place a contract for it until later. In fact, contract was awarded in February of this year for only the substructure, the total low bid for which was $274,789, being that of A. Bentley & Sons, of Toledo. The largest items of this bid were 3,800 cubic yards of concrete masonry at $23.50 a yard, 3,800 cubic yards of earth excavation below elevation 85 at $10.50, and 4,500 cubic yards of earth excavation above elevation 85 at $5.20. A description of the pumping station and some of its more interesting details will be given later on.

It was decided to provide a system of intercepting sewers estimated to have sufficient capacity for conditions anticipated for the year 1960; this included allowing for increase in area of the city, increase in population and increase in per capita sewage. As very little storm water is provided for in the intercepting sewers, possible increase in run-off due to more impervious paving and other conditions did not have to be considered. Owing to the advantage to Toledo of preserving sanitary conditions throughout the water sheds of the creeks passing through the city, whether or no all of the area draining to them might be included within the political limits of the city, provision is made for receiving sewage from portions of these areas that lie outside of the anticipated city limits of 1960.

Not only were the sewers designed to be adequate for 40 years hence, but in a general way a study was made of the possibilities at such future date of providing for the increased capacity that might then become necessary. The engineers did not attempt to definitely plan any special methods of relief for adoption at that future date, since several alternatives seemed to be practicable and it could not be foretold which sewers would first need relief, but study of the problem was made in order that no features of the existing plan might be so designed as to restrict or render unnecessarily difficult the adoption of these relief measures.

The 1960 city limits were assumed to enclose an area of 32,687 acres. Population densities were assigned to various sections of this area which resulted in an estimated population of 711,690. The present average density is 15.9 persons per acre, and the estimated 1960 density figures 21.8 persons per acre within the city limits, or 16.6 per acre over the entire drainage areas considered.

As stated, the sewers at present in use are on the combined system, but it is recommended that in future extensions separate sewers be provided for the house sewage and that these be built with special attention to securing water-tightness, both to avoid overtaxing the capacity of the intercepting sewers and also to reduce needless pumping at the pumping station. It is estimated that by 1960 70 per cent of the total area will be sewered under a separate system.

CALCULATING SEWAGE VOLUME

In calculating the volume of sewage to be carried by the intercepting sewers and by the separate sewers to be built, a distinction was made between sewage from industrial and commercial areas and that from residential areas. This necessitated a forecasting of the use of all the areas of the city; which, in 1960, would be devoted largely to industries, which to commerce, and which to residences. "The availability of rail and water transportation facilities, proximity to a supply of industrial workers and a supply of water for industrial and commercial purposes other than the filtered water of the city, the arrangement of street car lines in the future and contemplated improvements in the business district were factors in determining the location of future industrial and commercial areas."

Over 94 per cent of the water services in Toledo are metered, and it was therefore possible to obtain a very accurate indication of what the domestic water consumption is and from a study of this to estimate the amount of domestic sewage. Additional data of great value were obtained from a water waste survey which was being conducted for the city by the Pitometer Company during the time that this sewerage investigation was in progress. Also, gagings were made on ten large sewer outfalls during the summer of 1916 and 1917, in connection with which a census study was made of the area tributary to each of these outfalls in order to learn, for each, the total population, population connected to the sewers with modern plumbing, population connected with vaults and sinks, population not connected in any way, number of houses, class of dwellings and location of industrial and commercial establishments. A study was made of the water supply statistics for 1917 also.

These data were carefully studied and compared in order to learn existing conditions, and with these as a starting point an effort was made to forecast as closely as possible what the future conditions would be, studying in this connection the bases of design used under similar conditions in making forecasts for other cities.

In studying the water supply statistics, it was assumed that consumers using 100,000 gallons a month or more were either commercial or industrial and those using less than this amount were domestic. On this basis 34 gallons per capita was rated as domestic, 34 as manufacturing, 7 gallons as public use and 17 unaccounted for, the total being 92 gallons per capita.

The meter record of every industrial concern in each of the sewerage districts gaged was investigated. To the quantity of city water sold to these concerns, as shown by the meter records, were added amounts obtained from their private supplies; and from this total, deductions were made for amounts that did not ultimately reach the sewers and the result taken as the average daily quantity of industrial sewage. Similar investigations were made of commercial establishments.

The Pitometer Company during two days in March gaged the flow into a large residential district in which practically every house is provided with modern plumbing, this district containing most of the larger and better class dwellings in the city. A census of this area showed the population to be 20,100. The total average daily flow, after deducting the industrial supply, was 1,010,000 gallons. This gives a domestic consumption of 50 gallons per capita daily. It is assumed that the domestic sewage would be slightly less, or 47 gallons, and that for the city as a whole the average daily discharge would be about 43 gallons per capita per day for those dwellings equipped with modern plumbing.

Since most cities show a marked tendency for increasing domestic use of water with increasing use of plumbing appliances in the residences, it was estimated that by 1960 the water consumption will have increased 21 per cent and the average daily discharge of domestic sewage would be 121 per cent of 43 gallons, or 52 gallons per capita daily.

The investigations above referred to and outfall measurements showed an average daily discharge of industrial sewage of 8,200 gallons per acre per day from one area and 10,100 gallons from another; also 13,350 gallons per acre per day of commercial sewage from the second area (no commercial sewage from the first area); an average of 32 gallons per capita per day of domestic sewage (based on total population within the district) from each of the areas; and 570 gallons per acre per day of ground water from one area and 600 from another.

Maximum Rates.—Investigation was made to determine maximum as well as average rates of water consumption and consequent sewage flow. The waste survey had developed figures indicating that during hot weather about 7 per cent of the average daily consumption was used for lawn sprinkling; this being based upon a comparison of the Pitometer records on clear, hot days with records in the same districts on days during which rain fell.

The average daily pumpages of the public water supply for 1917 and 1918 were investigated, and temperature and weather conditions were investigated for the days showing maximum pumping rates. Maximums occurring on hot, dry days were diminished by 7 per cent to allow for water used in sprinkling lawns and which therefore did not reach sewers. This gave a maximum for winter conditions of 122 per cent of the average for one year and 133 per cent for the other; and for summer conditions gave a maximum of 130 per cent of the average one year and 127 per cent the other. Investigations of the pumpage records for 12 years show that the pumpage on maximum winter days varied from 108 per cent to 133 per cent of the yearly average, the average for the 12-year period being 121 per cent. It was therefore decided to take 125 per cent of the average daily discharge of domestic sewage as the maximum daily discharge, which gave 125 per cent of 52 gallons or 65 gallons per capita daily.

TABLE SHOWING POPULATION TRIBUTARY, TOTAL CAPACITY AND MAXIMUM DRY WEATHER FLOWS FOR INTERCEPTING SEWERS IN VARIOUS CITIES

City	Population Tributary in Thousands	Total Capacity g.c.d.	Maximum Dry Weather Flow g.c.d.
Boston, Mass.	600	258	150
Providence	337	363	145
Milwaukee, 1889	562	419	241
Lynn	...	312	150
Detroit District	...	329	...
Buffalo District	...	482	...
Milwaukee, 1910*	850	350	248
Milwaukee, 1910*	850	350	271
New Bedford	220.7	400	125
Metropolitan High Level	986	300	200
Mass. North Metropolitan Interceptor	513	239	...
Metropolitan Charles River Interceptor	157	224	...
Toledo, Ohio*			
Ten-Mile Creek	312.8	233	198
Swan Creek	207.76	335	230
West Side†	304.76	340	272
East Side	164.27	331	306

*Water supplies nearly 100 per cent metered.
†Flow in Swan Creek interceptor carried through West Side interceptor.

TABLE SHOWING RELATIONS OF INDUSTRIAL, COMMERCIAL AND DOMESTIC FLOW FOR VARIOUS CITIES (Design Basis)

Date of design	1919	1910	1915	1915	1913	1906	1911
Date of ultimate estimate	1960	1950	1940	1950	1950	....	1940
Population in thousands	781,900	862,000	1,500,000	800.000	720,000	230,000	87,200
Industrial area	4,139.05	3,762	4,800	4,065	8,180	622	1,256
Commercial area	837.60	84	700	568	723	66	....
Industrial Q. g. a. d.							
Average, used in design	8,000	9,350	8,000	....	4,500	....	4,444
Maximum, used in design	12,000	16,800	12,000	16,000	9,000	24,000	8,000
Commercial Q. g. a. d.							
Average, used in design	15,000	17,700	33,000	....	....	....	....
Maximum, used in design	30,000	29,800	50,000	60,000	40,000	30,000	....
Industrial Q. g. per 1,000 population							
Average	42,340	40,900	25,600	....	51,000	....	66,800
Maximum	63,510	73,400	38,400	81,500	102,000	....	115,650
Commercial Q. g. per 1,000 population							
Average	16,060	17,400	15,400	....	....	....	....
Maximum	32,120	29,200	23,400	42,600	40,100	8,160	....
Ground water g. a. d.							
Average	600	1,600	....	....	750	....	....
Maximum	800	1,660	500-1,000	1,000-1,850	750	1,960	....
Domestic Q. gals. per capita							
Average for year	50	50	....	....	....	....	....
Average, maximum days	65	50	114	....	86	100	75
Maximum rate	113*-158*	125	228	285	135	200	150

Note—*Maximum rate depends on population of drainage area.

Further studies were made to determine maximum rates. Hourly readings were taken at the pumping station from one Friday until the following Friday. Sunday showed 87.5 per cent of the daily average for that week, Monday 110.8 per cent, Tuesday 103.9 per cent, Wednesday 99.5 per cent, Thursday 97.4 per cent, Friday, 100 per cent and Saturday 100.9 per cent. The hourly figures showed a maximum hourly Monday rate of 165 per cent of the mean daily rate for the week; but as this included a uniform consumption for industrial and commercial purposes it was not considered a criterion as to the hourly fluctuations in the domestic sewage. "From a study of the investigations made by the Pitometer Company it develops that for an average day the maximum hourly rate of water consumption is 152 per cent of the mean consumption for an average day in those districts which are largely residential. A mean of the gagings of ten sewer outfalls shows a maximum hourly rate of discharge on an average day of 133 per cent of the mean for an average day and also the maximum hourly rate on Monday as 168 per cent of the mean for an average day. These figures include ground water leakage, which is constant, but from them it will be seen that the maximum hourly rate on Monday is 126 per cent of the maximum hourly rate on average days.

"If the maximum hourly rate of water consumption for an average day is 152 per cent of the mean for the day, as shown from the Pitometer measurements, and the maximum hourly rate on Monday is 126 per cent of the maximum hourly rate for an average day, as shown by the sewer gagings, then the maximum hourly rate of domestic water consumption or sewage discharge on Monday is 152 per cent times 126 per cent equals 191 per cent of the average, since the fluctuations in water consumption for domestic purposes and the discharge of domestic sewage may be fairly taken as equal."

Another calculation was made by taking the hourly fluctuations of sewage flow for an average day and for Monday and correcting these for the ground water leakage, which was assumed as constant and had been determined as equal to 600 gallons per acre per day. New hourly rates were thus obtained and expressed as a percentage of the new average, and this gave a maximum hourly Monday rate of 194 per cent of the mean daily rate for an average day.

In the matter of industrial sewage, gagings in the industrial districts showed the maximum to be 140 per cent of the average and the maximum for 1960 was therefore taken as 12,000 gallons per acre daily.

Investigations in commercial districts showed the average daily discharge to be 13,350 gallons per acre daily and the discharge for 1960 assumed to be 15,000 and the maximum as double this or 30,000, since the gagings showed a maximum twice the average.

In determining the ground water leakage, observations were made on the sewer outfalls in the spring when the level of the ground water was high and these indicated the ground water leakage to be 133 per cent of the leakage under normal conditions. Leakage under such conditions had been estimated at 600 gallons per acre per day and therefore the maximum ground water leakage was estimated at 800 gallons. In outlying districts, where it is anticipated that the population density will be low and sewers widely scattered, the ground water leakage was estimated in terms of leakage per mile of sewer rather than per acre. For these it was estimated that the ground water leakage under normal conditions would be 26,000 gallons per mile of sewer and under maximum conditions 32,000 gallons. This estimate was based partly upon observations made in March upon about 11 miles of sewer in one of these districts, where the ground water leakage was found to be approximately 26,400 gallons per mile of sewer.

(To be continued)

Water Department Uses Machinery

In his report for the year 1920, Alfred E. Martin, superintendent of the water department of Springfield, Mass., reported that beginning with the early part of the season a trenching machine and backfiller were used and "have proved a most unqualified success, as we have been enabled to carry on our work efficiently and swiftly with the small gang of men we have been successful in keeping; for the labor question, while not quite so bad as during the previous year, has, nevertheless, not been at all what it used to be, and notwithstanding we have paid the highest wages of any department of the city, only a limited force of men could be maintained.

"In the line of improvement work, our largest job was the laying of a 16-inch main in Boston road from the vicinity of Rosewell avenue to Pasco road, a length of 8,337 feet, and a speed of a little under 200 feet per day was attained with a gang averaging twelve men. This could probably not have been done without the aid of machines above mentioned with a gang of less than 60 to 75 men."

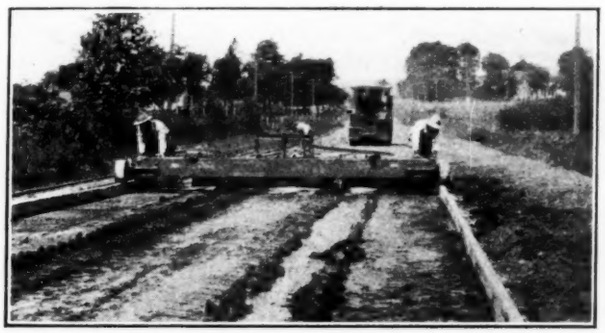
During the year 1920 the Springfield water department replaced 116 service pipes out of a total of 16,328. Concerning this, Superintendent Alfred E. Martin said in his report: "It will be noted that there has been quite a decrease in the number of services replaced this year over those of preceding years, there being something less than one-third as many as heretofore. The reason for the above is the purchase and use of a small tool called the 'Staples Pipe Cleaner,' with which we have been enabled to restore the efficiency of many service pipes which would otherwise perforce have been replaced by new ones; we have thus saved our consumers many dollars as well as ourselves much work, and incidentally the cutting and subsequent repairing of many holes in permanent paving, which of itself is of much benefit to our streets and undoubtedly much appreciated by our friends of the Streets and Engineering Department. This tool costs less than $50 and was purchased upon the recommendation of Mr. Irving H. Henderson, who succeeded Mr. M. L. Miller as foreman of our meter

division, and who had used the instrument very successfully while in the employ of the city of Cambridge in a similar position to that which he holds with us. It has saved our water takers approximately $15,000 during the past year and has thus demonstrated its usefulness and value."

Concrete Highway Construction in South Chicago

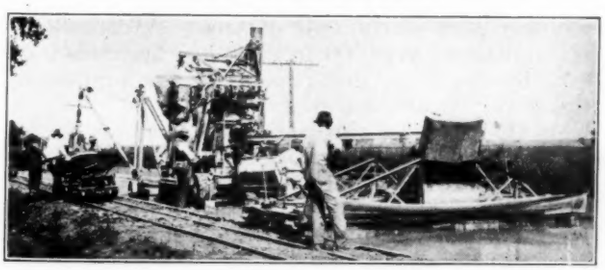
Various standard operations adopted on Federal Aid Projects 1 and 2, concrete highways in South Chicago, are illustrated by the following pictures from the files of the Bureau of Roads and Highways of the United States Department of Agriculture.

After the road bed had been approximately graded, the forms were carefully set to line and level for the sides of the concrete slab, the subgrade was accurately trimmed and planed by standard machines hauled by steam rollers that compacted the foundation in advance of them, the whole operation leaving a smooth and uniform surface to receive the concrete.



FINISHING FOUNDATIONS WITH SUBGRADE PLANER

DUMP CAR TRAIN ON SERVICE TRACK ALONGSIDE FINISHED SUBGRADE



MIXING AND FINISHING MACHINES IN OPERATION

CURING CONCRETE PAVEMENT BY PONDING METHOD

Aggregate was delivered from central storage to the mixer by hopper-bottom tilting dump cars hauled on a narrow-gauge service track alongside the sub-grade and by wooden batch boxes hauled on flat cars on the service track.

The aggregate was handled by a derrick attached to the frame of the mixer and operated by its engine, which dumped the material into the elevating skip of the mixer and enabled the latter to work continuously.

As the mixer advanced it was followed closely by a finishing machine that compacted and smoothed the surface of the concrete. The finished concrete was cured by the ponding system with two or three inches of water maintained over its surface by low earth or clay dams on the longitudinal edges and connected by transverse dams of the same sort near enough together to offset the water surface in accordance with the grade encountered. Lakewood equipment was installed.

Tempe Bridge Sub-Structure Repairs

Channel pier supporting two 125-foot concrete arch spans settled nearly 11 inches and was underpinned by a reinforced concrete girder supported on groups of cylinder piers sunk to rock both sides of old pier.

The highway bridge across the Salt river, at Tempe, Ariz., has 11 clear spans of 125 feet made with pairs of reinforced concrete arch ribs supported on concrete piers, part of which were carried to rock in open excavation, and part had 11 x 24-foot bases sunk below the river bottom and supported on two 6-foot steel cylinders sunk to rock and filled with concrete. The bridge was completed in 1913 and after a flood in 1919 scoured out some of the sand and gravel around its base, one of the piers settled 4¼ inches, and within a few months settled again ½ inch, and 1⅛ inches, and finally 5 inches more, moving down-stream bodily about 1/10 foot.

Soundings taken after the final settlement showed that the bed of the river had been scoured away down to a thin layer of gravel overlying the solid rock and it was concluded that the concrete deposited under water at the bottom of the two cylinders had been of inferior quality, unable to carry alone the full load on the pier and therefore when the original total bearing surface of 312 square feet on the bottom of the pier was reduced to about 65 square feet on the bottom of the cylinders by the removal of the sand under the overhanging pier base, the greatly increased load on the cylinders was sufficient to buckle the unbraced lower portion of the thin steel cylinder, permitting the briage to settle.

To support the superstructure, which was not very materially damaged, and to prevent further trouble, it was determined to underpin the upper part of the old pier with new foundations carried down to solid rock outside the old cylinder, thus adding increased support without removing any of the existing support.

After the flood was over, the river began to deposit sediment around the old pier, filling the pit that had been scoured there, but did not prevent the pier from taking another drop, increasing the settlement to a total of about one foot and making it necessary to take the measures to safeguard the bridge.

About 500 sand bags were dumped in the water around the pier to prevent additional scouring, and falsework towers were built under the crowns of the arch ribs of the second spans from the settled pier, at the nearest points where the depth of water permitted it, to support the floor slab, which was continuous except for expansion joints over the crowns of the arches.

The arch ribs in the two spans adjacent to the settled pier were wedged to bearing on falsework trestle bents supported by piles driven beyond the outer edges of the bridge because there was not room to drive them under the arches.

The pier was enclosed by a 30 x 31-foot cofferdam of Wakefield sheet piling driven with a steam hammer and hydraulic jet.

The water in the cofferdam was pumped down to a level not more than 5 feet above the tops of the old cylinders, by an 8-inch centrifugal pump operated by a 40 h. p. gasoline engine.

Three 5-foot steel cylinders were set close to each of the long sides of the pier and were sunk by submerged interior excavation with an orange-peel bucket. They descended easily until they encountered buried driftwood, which was finally cut away with long steel chisel bars after two of the cylinders had been considerably damaged by ineffective blasting with ¼-pound sticks of dynamite.

After passing the obstructions, the cylinders were readily sunk to rock but could not at first be pumped dry on account of the large amount of sand and water entering through the irregularities of the surface of the rock under the bottoms of the cylinders. Attempts to close the holes by grouting the sand were partially successful when the grout was forced in under hydraulic pressure rather than steam pressure. The grout did not, however, all of it set up well, and it finally became necessary to close the openings under the cutting edge by sheet piling made of 6 x 1-inch boards driven by hand inside the cylinder, after the excavation had been carried as far as possible by the orange-peel buckets.

The cylinders were sunk to rock, the surface of which was cleared off and drilled to receive four 1¼-inch square vertical anchor rods grouted in in each cylinder. Two of the cylinders were found to be so badly distorted by the blasting that they had to be replaced by new ones. After the bottoms of the cylinders had been sealed with concrete, the upper part was filled with concrete to an elevation of about 6 feet above the bottom of the old pier base, where the steel shells of the new cylinders were cut off.

Holes parallel with the axis of the bridge were then successively cut through the old base and a wide reinforced concrete girder supporting the entire base of the old pier shaft from the tops of the new cylinders was built in successive sections.

Water Revenues in New London

In the report of the Board of Water and Sewer Commissioners of New London, Conn., for 1920, appears an explanation of a policy adopted by the board which will be of interest to many other cities.

In connection with a move to increase the rates in order to meet increased costs, a committee appointed to study the matter found that during the 47 years covered by the accurate record of the water works, $1,142,400 had been furnished by water consumers to other departments of the city, both public and semi-public. This amount is $209,705 in excess of all payments by the city in interest and appropriations, in behalf of the water works. "It was shown that the water department had partially supported other departments of the city and semi-public institutions for many years. It was developed that many cities charge for all water used by the public and that this practice is advocated by many cities. The states of Indiana and Wisconsin make it compulsory by law. A decision of the Wisconsin Railroad Commission states that the cost of water service should be charged to the city for furnishing water to schools, fountains and other public buildings, and for flushing hydrants, and in case of fire. The commission closes its opinion as follows: 'In other words, private water companies have borne a part of the burden which properly should have been borne by the taxpayers'."

The question was raised whether the water board could lawfully give away any property of the department, including water, and it was decided that it could not. It was also believed unquestionably unjust that water consumers should pay any part of the cost of sewer extensions or maintenance; $118,000 in cash has been contributed by the water department for the support of the sewer department to date.

As the result of this policy, all users of water, including city departments, are charged for the water used at meter rates, except that used through fire hydrants for extinguishing fire and for other public purposes. The board refuses in the future to grant abatements for excessive consumption unless the same is caused by the neglect of the board.

Laying 2,210 Sq. Feet of Pavement Per Day

G. P. Scharl, general contractor, Muskegon, Mich., has broken his own previous record by pouring 1,105 lineal feet of 18-foot concrete road, average thickness 7.666 inches, in nine hours. The work was done on a contract with the Michigan State Highway Department for construction of Sections A and B, Federal Aid Road No. 43, Muskegon county, Mich.

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Water Works Benefit by Adversity

The manner in which water works officials have come through the trials and difficulties occasioned during the past two or three years by the constantly increasing costs of labor and materials required for conducting their departments is greatly to their credit. Most lines of business found it possible to offset, to some extent at least, increased costs by increasing the rates or prices of their own output. The large percentage of water works departments and companies, however, either were denied this privilege or as a matter of policy refrained from advancing rates, endeavoring to meet conditions in other ways. What these ways were in the case of several hundred plants is told briefly in an article in this issue.

Less than one-quarter of the water works increased their rates, and less than one-half of them borrowed money, removed it from their reserve or depreciation funds, or secured it in any other way except by increasing their incomes.

The most commendable of the various expedients adopted for meeting the increased costs are found in the manner in which superintendents introduced improved methods or plant for reducing operating expenses. These would seem to be of the greatest value not only to these plants but also to others to whom they might well furnish an example, not only because they enabled them to weather this difficult period, but because it seems probable that these same methods can be continued and thus permanently decrease maintenance costs with a corresponding increase in profits to the private concerns or decrease in rates for municipal plants.

The savings already made have been more than absorbed by increased costs, while continued saving for some time to come will be necessary for carrying out improvements and repairs which were necessarily deferred. If, however, these efficiencies and economies are continued thereafter they will constitute a permanent benefit to the plants and prove the truth of the saying that "wise are those who profit by the lessons of adversity."

Mortar Cushions for Block Pavements

The experience of Newark, N. J., with mortar cushion under a wood block pavement, which is described in this issue, is extremely interesting and suggestive. During the past few years this type of cushion has come into more or less general use as a substitute for sand cushions. One of the advantages claimed was that the mortar cushion would not shift under the influences of traffic or other external forces, as sometimes happened where a sand cushion was used. Apparently this was not the case in Broad street, however. The author of the article states that water that got under the block pavement by way of the street railway tracks "caused the disintegration of the cushion. In some cases the cushion was washed out entirely from under the blocks and in other instances the original one-inch cushion was increased to two or three inches, and a depression was thus caused in one place and a corresponding hump in the pavement immediately adjacent."

The writer very explicitly states, however, that this action took place only on certain parts of this street, and that other streets similarly laid, but without street railway tracks, have given perfect satisfaction.

We have noticed similar action in this and other cities and attributed it not only to the admission of water by way of the track but also to the slight vertical movement of the rails. This movement raises the blocks that are in contact with the rails and as each car passes, brings them down suddenly and violently onto the cushion, thus breaking up the cushion and gradually reducing it to the consistency of sand. In the case of Broad street, it is probable that water acted also and finished the deterioration made possible by this breaking up of the mortar. Where there were no

rails the mortar cushion appears to have withstood all the pounding of traffic and maintained the pavement in perfect surface.

Whether the deterioration was due to either of these causes singly or to both combined, the plan adopted by Newark in making its repairs would seem to suggest the means for avoiding such deterioration in original construction. This is, to lay a strip of rich mortar along the edge of the pavement adjacent to the rails, bringing the top of this practically flush with that of the mortar cushion which is to be placed, and after allowing this to set, cover it with a thin layer of asphalt. The mortar cushion would then be spread in the usual way over the remainder of the pavement and the blocks laid as in ordinary construction.

This action of rails and method of using the mortar cushion where rails exist would apply of course to brick and other pavements as well as wood block.

We still have to contend with the tendency of the rails to raise and lower, with a pumping motion, the blocks that are in contact with them. To prevent this, there would seem to be considerable to be said in favor of the use of a thin steel plate placed vertically between the blocks and the rail and immediately in contact with the latter, this plate having a flange at the bottom which is bonded into the concrete base of the pavement. This would permit the rails to slide over the outer surface of the plate without disturbing the blocks, assuming only that the friction between plate and rail was not sufficient to tear the plate from the base or lift the base with the plate. By using a plate not more than one-eighth of an inch thick and set flush or possibly one-eighth of an inch below the surface of the pavement, the plate would not be appreciable to traffic or in any way interfere with it.

Growth of Registration Areas

The federal government has established certain rules for the keeping of vital statistics calculated to secure reliable returns, and states or minor subdivisions that adopt and follow these rules are known as "registration areas." The increasing realization of the importance of vital statistics is indicated by the rapid growth in these areas. This idea was put into effect in 1880, with Massachusetts and New Jersey as the only registration areas. By the 1890 census, Connecticut, New Hampshire, New York, Rhode Island and Vermont had been added, and also Delaware, although this state was dropped from the registration area in 1900. Maine, Michigan and Indiana were added in 1900, and other states in succeeding years until, in 1919, the only states east of the Mississippi not included were West Virginia, Georgia, Alabama, Arkansas and Iowa, and the first of these has recently adopted regulations admitting it to classification in the registration area. In addition, seven of the remaining seventeen states west of the Missisippi are now so included.

Considered from the points of population, the record is even better. In 1919, while states containing 55.5 per cent of the total area of the country were included, these states contained 81.1 per cent of the population. In addition, there were eighteen cities in non-registration states whose returns are accepted by the federal government.

The study of vital statistics is of the greatest importance in various ways, one of the most easily recognized being that of demonstrating the effectiveness of the inauguration and enforcement of health regulations, activities of state boards of health, etc.

It is to be hoped that long before the 1930 census the entire country may be found enrolled in the registration area.

Maximum Immigration

Under the Dillingham percentage immigration law the number or immigrants that can be admitted to this country during the fiscal year, beginning July 1 totaled 77,206 from the United Kingdom, 68,039 from Germany, 19,956 from Sweden, 12,116 from Norway, 42,021 from Italy, 34,347 from Russia, 25,800 from Poland, 14,269 from Czecho-Slovakia, 7,444 from Austria, and smaller numbers from other European countries.

Construction Conditions Improving

A summary of 80 replies received by the Southern Pine Association to a questionnaire sent out by them to the largest cities in this country, indicates that there is an ample supply of building trade labor; that there is a marked increase of labor efficiency; that wages have been decreased in only about one-half of the cities replying; that in these cases the reduction has been from 15 to 20 per cent for carpenters and bricklayers, and from 25 to 55 per cent for common labor.

An average reduction of 35 per cent on retail prices of all staple building materials has been reported from 42 cities, 40 per cent on lumber from 37 cities and 29 per cent on brick from 12 cities. In general, money will only be loaned to 50 per cent of the value of new buildings, and in 46 cities there is a report of shortage of money for building purposes. A general increase in the demand for southern pine lumber is shown by the amount of orders on hand at the mills, which have doubled since the first of the year, and by the reduction of the stock in hand, which has been decreased about 18 per cent since January 1.

A positive indication of better conditions and encouraging progress in construction matters is the report by the Southern Pine Association that the orders for lumber that averaged 694,049 per mill for the week ending April 29 are 20 per cent greater than ever before reported for the corresponding weeks of other years. The next highest figure for the same week was in 1899, when the orders amounted to 576,409. The record for the week ending April 29 is 50 per cent higher than for that of the last week in March.

American Water Works Convention

Narration of the proceedings of the several days. More than seven hundred in attendance. Development of the functions of the Standardization Council. The society's finances. Other features of a most successful convention.

The 41st annual convention of the American Water Works Association, held last week at Cleveland, Ohio, was an unusually successful one from almost every point of view. The program was carried through almost without change, each paper being presented at the time scheduled by the program, with the exception that three papers describing some features of the Cleveland water works were crowded out by lack of time and that two of the papers listed were not received. A decided improvement on former conventions was the beginning of most of the sessions promptly on time. There was little important business conducted at the convention, such as changes in constitution, and no evidences of anything but the most harmonious relations in all matters.

The most popular event, as in previous conventions, was the selection of place of meeting for the next convention. This selection was made by a vote of both the active and associate members at 11:30 on Thursday morning, at which time about 400 members were present in the convention hall. The committee announced that invitations had been received from Baltimore, Detroit, Kansas City, New Orleans, St. Joseph, Mo., Atlantic City, Washington and Philadelphia. The committee, giving first consideration to hotel and convention hall capacity and second to the amount of new work by water departments that would be available for inspection, recommended Baltimore as first choice, with Kansas City and Philadelphia as second. On the first ballot Philadelphia received 148 votes, Baltimore 131, Kansas City 68, New York City 6, Detroit and Atlantic City each 5 and Washington 1. As the regulations of the society require a majority vote, and as it had previously been voted to include in the second ballot, should one be necessary, only the three cities receiving the highest votes in the first ballot, Philadelphia, Baltimore and Kansas City were presented for the second ballot. Kansas City withdrew, leaving only Philadelphia and Baltimore, the former winning by a vote of 197 to Baltimore's 188.

Another interesting procedure of the convention was the election of the nominating committee and the announcement by that committee of its choice for officers for the coming year. On Tuesday noon the members from the various districts got together and made their selections for members of the nominating committee. At the evening session the following were chosen: District No. 1—Pat. Gear; District No. 2—J. Walter Ackerman; District No. 3—William R. Edwards; District No. 4—H. E. Keeler; District No. 5—Ernest B. Black; and District No. 6—F. H. D. Lawlor. On Thursday this committee reported its nominations as follows: For president, W. S. Cramer, of Lexington, Ky.; for vice-president, George W. Fuller, of New York; for trustees—First District, George W. Batchelder, of Worcester, Mass.; and for the Fourth District, Joseph W. Ellms, of Cleveland; for treasurer, William W. Brush, of New York.

At the opening session, Messrs. Carlton E. Davis and Goodell were appointed a committee on resolutions, and at the Thursday morning session they reported a resolution of thanks to the various individuals and associations of the city of Cleveland that had contributed toward making the convention such a pleasant and successful one, which resolution was adopted by standing vote.

Dr. Bartow reported for the executive committee that it had reappointed Mr. Diven as secretary, had appointed Prof. John H. Gregory as chairman of the publication committee and Abel Wolman as editor. Mr. Wolman succeeds Mr. Goodell, who insisted upon the acceptance of his resignation of this position. The society adopted a resolution of thanks to Mr. Goodell and also to Mr. Johnson, the chairman of the finance committee last year, for their services to the society. The finance committee appointed for the coming year is George C. Andrews, J. Walter Ackerman and C. R. Henderson.

The matter of society finances received more attention than any other business feature, membership increase being included under this heading. The finance committee reported that while the expenditures of the year had been $15,136 the income had been only $13,128, thus showing a net deficit for the year of about $2,000, which reduced the cash balance by that amount. The society still holds Liberty Bonds to the par value of $12,000 as an investment fund, but this will be kept intact as long as possible. Even with the increase in dues which goes into effect this year, it will probably be necessary to borrow more or less money for immediate current expenses. Although the expenditures exceeded the income they did not exceed the budget allowance, although it was necessary to transfer certain funds from one account to another, as is permitted by the constitution. The finance committee, in spite of the financial condition of the society, but in view of the great importance which it attached to the work of the Standardization Council, recommended that $2,000 be appropriated for the use of this council in the budget for the coming year. The entire budget as recommended totaled $18,000. The income under present membership and with increased dues would amount to somewhat less than this and the solution for this financial difficulty seemed to be an increase in membership and this was strongly urged on all of the members.

The Standardization Council held a meeting on Monday afternoon previous to the formal opening of the convention and all attending were impressed with the importance of the work that had been done by this council and of the part which this work apparently is destined to play in the future activities of the society. The highest praise was given to the work of this council, of which George W. Fuller was chairman. On Tuesday the council presented its report to the society. This report is a most important document and we are expecting to publish it in our next issue.

It is, we believe, the practice of most societies to direct the president to deliver an annual address at the opening meeting or on the opening day. At this convention President Little's address was delivered at the opening of the Wednesday morning session. Its chief emphasis was placed upon the necessity of increasing the income of this society for carrying on the regular work of the society and that of the new Standardization Council; also suggesting the desirability of providing in some way a source of income for conducting investigations in water works matters. Following the address, and with reference to the point just referred to, Mr. Hazen suggested the possibility that some college might be induced to establish a department of water supply and funds be secured by which such department could conduct investigations referred to by President Little. Somewhat later, in connection with the report of the membership committee, the chairman of that committee Frank C. Jordan, appealed for more individual work by the members for an increase in membership. He referred to Mr. Liesen's success in securing 49 members in one year.

The only unsuccessful feature of the convention, if it can be called such, was the organization of group meetings, as had been suggested in the program; the idea being that members should report to the secretary on Monday morning or before which of several suggested topics they were interested in, and that those interested in each topic might then get together for a round-table discussion. Only three members displayed any interest in the matter and no such meetings were arranged.

The exhibit hall received even more than its usual attention from the members. It was on the same floor with and convenient of access from the convention hall. Seventy-four exhibits had space in the hall, these being as follows:

National Water Main Cleaning Co.
The Pitometer Co.
United Lead Co.
Water Works Equipment Co.
The Mathieson Alkali Works, Inc.
Fire & Water Engineering.
The American City.
Union Water Meter Co.
Eddy Valve Co.
Lock Joint Pipe Co.
Neptune Meter Co.
Thompson Meter Co.
Worthington Pump & Machinery Corp.
The Permutit Co.
Pittsburgh-Des Moines Steel Co.
The Kennedy Valve Manufacturing Co.
Pittsburgh Meter Co.
United Brass Manufacturing Co.
Hays Manufacturing Co.
Hauck Manufacturing Co.
Rensselaer Valve Co.
Engineering News-Record.
Engineering and Contracting.
Birch Pump Valve Co.
Canadian Engineer.
The Central Foundry Co.
The A. P. Smith Manufacturing Co.
Public Works.
S. R. Dresser Manufacturing Co.
Buffalo Meter Co.
American Manganese Bronze Co.
Sullivan Machinery Co.
Electro Bleaching Gas Co.
Builders' Iron Foundry.
Hersey Manufacturing Co.
H. W. Clark Co.
H. Mueller Manufacturing Co.
Glauber Brass Manufacturing Co.
Badger Meter Manufacturing Co.
Lead Lined Iron Pipe Co.
National Meter Co.
Wallace & Tiernan Co., Inc.
Payne Dean, Limited.
W. & L. E. Gurley.
Gamon Meter Co.
R. D. Wood & Co.
Bingham & Taylor, W. P. Taylor, Successor.
E. I. duPont de Nemours & Co., Inc.
Ford Meter Box Co.
The Refinite Co.
Chicago Bridge & Iron Works.
Flower Valve Manufacturing Co.
The Leadite Co.
The Underwood Typewriter Co.
United States Cast Iron Pipe & Foundry Co.
The Chapman Valve Manufacturing Co.
Allis--Chalmers Manufacturing Co.
Columbian Iron Works.
The Garlock Packing Co.
Ross Valve Manufacturing Co.
Simplex Valve & Meter Co.
Layne & Bowler Co.
The New York Continental Jewell Filtration Co.
National Tube Co.
East Jersey Pipe Co.
Neptune Meter Co., Ltd., of Canada.
Continental Pipe Manufacturing Co.
Ambursen Construction Co.
Van Gilder Water Meter Co.
Pittsburgh Filter & Engineering Co.
Addressograph Co.
Chippewa Pump Co.
The Wellman-Seaver Morgan Co.
Austin Machinery Corporation.

What might be considered as an exhibit was given in the audience hall in the form of moving pictures of trench digging by means of Austin and Parsons machines.

The attendance was excellent and notably so on the first day and the last. Before the formal opening of the convention on Tuesday, there had been registered 240 active members, 125 associate members and a considerable number of guests. The program called for the continuation of the discussions of Superintendents' Day from Thursday to Friday morning and it had been predicted by many that Thursday night would see a general exodus and that the Friday morning session would probably not take place. On the contrary, a most interesting meeting and discussion took place on Friday morning with more than 50 in the hall and a considerable number visited the filter plant and pumping station following this session.

The total registration at the closing of the books on Wednesday night was 363 active members, 170 associate members and more than 200 guests.

The social and entertainment features of the convention included an informal reception with dancing on Monday evening, where Mayor Fitzgerald delivered an address of welcome; a smoker on Wednesday evening enlivened with several vaudeville features; a most enjoyable boat ride on the lake on Thursday evening; and a visit in special cars to the filtration plant of the Cleveland water works, where a luncheon was served Friday noon. The ladies were entertained during the week by a trip to the Cleveland Yacht Club on Tuesday afternoon, a shopping trip Wednesday morning, a theatre party Wednesday evening, a card party Thursday afternoon and participation in the boat ride of Thursday evening and the trip to the filtration plant on Friday.

A description of the papers read at the convention and discussions of them by the members will be given next week.

State Road Equipment

Description of plant used by Second Division of New York State Department of Highways.

The Second Division of the New York State Department of Highways, comprising the counties of Albany, Clinton, Essex, Rensselaer, Saratoga, Schenectady, Warren and Washington, contains 1,100 miles of state road, maintained under the direction of Herbert S. Sisson, commissioner, and Harvey O. Schermerhorn, division engineer, with offices in Albany.

Headquarters for storage and repair of machinery, tools and equipment necessary for the proper maintenance of improved highways has been established at Waterford on a plot of ground about 600 feet long and 400 feet wide, situated on the banks of the Barge Canal.

Here there are two parallel 30 x 200-foot storehouses 75 feet apart and enclosing two sides of a rectangular yard, at one end of which is a 40 x 40-foot paint shop and at the other end a 70 x 70-ft. repair shop. All of these houses are built of concrete blocks, the workshops being provided with large windows and ventilators in the roofs, giving ample light and ventilation. The repair shop is equipped with a complete assortment of standard machine tools, such as lathes, drills and the like, operated by electric power, and is so arranged as to accommodate ten or twelve trucks simultaneously for repairs and allowing for removal of any one of them without disturbing the others. The facilities provided are considered ample for the maintenance of fifty or more trucks now in use by this division.

The storehouses provide shelter for six 10 and 6-ton road rollers, twenty Yeager concrete mixers, three special oil distributing machines mounted on automobile trucks, three rotary road sweepers, twelve graders and scarifiers and a supply of small tools and accessories. A gasoline and oil-filling station with hand pumps is also provided at a convenient place for supplying the trucks with fuel and oil.

In a storage yard back of the large workshop is kept a reasonable supply of tile, concrete and cast iron pipe, paving brick, timber and lumber, and pre-cast concrete posts for guide railing and danger and guide signs. This supply is drawn on as needed from time to time throughout the season. One or two carloads of cement is also stored in one of the storage sheds, to be used as needed.

The storehouses and shop are operated by a minimum force of four mechanics, three helpers and one night watchman, under the supervision of a superintendent.

PORTABLE CRUSHER PLANTS

This division is also equipped with a number of stone crushing outfits built by the New Holland Machine Company, of New Holland, Pa., which are used to provide necessary supplies of crushed stone in remote localities where it is difficult to get a commercial supply for macadam or concrete. The products of these plants consist of about 20 per cent of dust suitable for surface treatment cover, 50 to 60 per cent of No. 1 stone measuring ½ inch to ⅝ inch in diameter and the remainder of No. 2 stone measuring ¾ to 1½ inches in diameter.

These outfits are found to be much more economical than larger crushers and are excellent for light repair work and for patching old roads, rather than for new construction. The crushers, screens and elevators are operated by International Harvester Company gasoline tractors. The crushers will receive broken ledge stone or hardheads up to 6 x 12 inches and the whole outfit is easily hauled from place to place by the 20 h. p. tractor. With two men feeding it the crusher has an output of from 20 to 30 cubic yards per day.

DISTRIBUTING SURFACE MATERIAL THROUGH TRUCK CHUTES

Crusher dust, sand or screenings for cover is first distributed along the road by 3-ton trucks provided with power hoist and end-dump bodies which have two hinged gates, one on either side of the rear end, with bottom plates or sills projecting a little beyond the face of the gate so as to deliver the material into a reversible, detachable chute that is connected to the truck at the proper inclined angle so as to discharge on either side of the roadway and deposit the materials either in separate, small piles, or in long windrows as the truck moves along.

This device eliminates the necessity of handling material by shoveling in the unloading operation. The chutes are operated by one man who walks behind the truck and opens or closes the gate, thus permitting the material to be deposited in piles from which it is spread over the fresh oil. The chute is also used in a similar manner for building up shoulders along the pavement. It has been found very satisfactory and economical for oiling and shoulder work.

How Water Works Met Cost Increases

By economy, efficiency and other methods of reducing expenses; by increasing business or rates; by borrowing money; and by other methods.

Among the data contributed by water works superintendents and other officials in response to a questionnaire sent out recently, the replies from which were published in our issue of June 4, was one giving the method of meeting the increased costs of the past three years. The replies to this question proved to be very interesting and instructive, and most of them were suggestive of more detailed consideration than a mere tabulation.

Of those giving definite replies to this question, 275 were municipal plants and 78 were private.

The plants replying might be divided into four classes—those that reduced expenses, those that increased income, those that obtained funds over and above their income by borrowing or otherwise, and those that simply went into debt. A fifth fortunate class reported that being small gravity plants, with no employees, their increases in costs were insignificant.

Among those that decreased expenses, 5 reported having done so by changing the plant from steam to electric power, and one by changing from steam to oil. One reduced fuel cost by method not particularized. Seven managed to secure greater efficiency in the operation of the plant and 12 greater economy. Nine reduced consumption by metering a larger percentage of their services and 1 by a pitometer survey, while 2 decreased the amount of unaccounted-for water and 13 reduced consumption by methods not particularized The greatest number, 37, reduced expenses by curtailing the force of men employed, 19 did less new work in the matter of extensions and improvements than would otherwise have been done, and 2 curtailed in repairs. One frankly stated that it reduced expenses by giving poorer service than formerly.

In order to increase their incomes, 82 plants, or 23 per cent of the total, increased their rates; 23 increased the amount of business done and one developed a water power and sold it for commercial purposes.

Among those that obtained money from sources other than revenues, 61 used money from their surplus, 34 obtained funds from the city treasury, one used a part of its sinking fund, 29 borrowed money by issuing bonds or otherwise, and in 5 cases, presumably where the water works and an electric light plant were operated together, the electric plant carried the deficit. Only 3 plants apparently are to be classed under the fourth heading, one being a private plant which passed its dividends and the other two simply stating that they ran behind.

Several of these replies would seem to indicate that those in charge were of that class who compel success by profiting by the lessons of adversity. For instance, 23, under the stimulus of the hard conditions, managed to increase their business sufficiently to make up a threatened deficit. Increased business of a water company usually means a permanent increase; moreover, it would appear probable that the methods of obtaining such increase developed under this stimulus, once having been learned, will continue to be used to the permanent advantage of the plant. Also, the plant which realized that it had potential water power which could be developed and sold has secured for itself a permanent asset that might have lain unutilized for years except under the impulse of the recent necessity.

It is interesting to note also that 6 of the plants found that by changing from steam to another source of power they were able to save in operating expenses. This also presumably will continue permanently as an economy which might otherwise have been overlooked or at least delayed had ordinary conditions continued. Similarly those that found it possible to obtain greater efficiency and economy by more careful operation or modified methods have undoubtedly learned a lesson by which they will continue to profit. The same applies to those who found it possible to reduce consumption by metering, making pitometer surveys or otherwise.

On the other hand, it is to be hoped that some of the methods of meeting these recent difficulties will be forgotten as speedily as possible by the plants employing them. This includes the using of money from their surplus, but especially the use of money from the sinking fund, which latter use would be illegal in some states and should be in all.

Altogether, it is certainly encouraging that one-third of the plants found it possible to weather the financial storm without either obtaining money from other sources or increasing their rates; and that, including those that made a certainly justifiable increase in rates, more than 60 per cent of the plants have succeeded in pulling through without borrowing money or obtaining it in any other way from outside sources or without curtailing the services.

Robert Ridgway Honored

About 750 engineers, contractors, financiers, municipal officials and guests participated June 9 in a testimonial dinner at the Pennsylvania Hotel, New York City, given in affectionate appreciation to Robert Ridgway, formerly engineer of subways and recently appointed chief engineer of the Transit Commission of New York City.

J. Waldo Smith, chief engineer of the Catskill aqueduct, was toastmaster, and the other speakers were: Hon. George McAneny, chairman of the new transit commission; Hon. Edward S. McCall, former chairman of the Public Service Commission; General J. F. O'Ryan, Transit Commissioner; Wm. Barclay Parsons, the first chief engineer of the New York Rapid Transit and Subway system, and J. F. Galvin, former president of the Board of Water Supply.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can Arch Centers Be Supported?

Directly from the ground; from the substructure, from trusses, from intermediate towers and on trestle work.

During the time that the concrete is being placed and developing at least 75 per cent of its ultimate strength, the forms in which the arch spans are concreted must receive reliable and unyielding support that should be arranged for quick and complete removal, gradually and uniformly and under perfect control. This is generally accomplished by supporting the forms on the structures called arch centers, which, when removed, are said to "struck."

SHORT FRAMED CENTERS

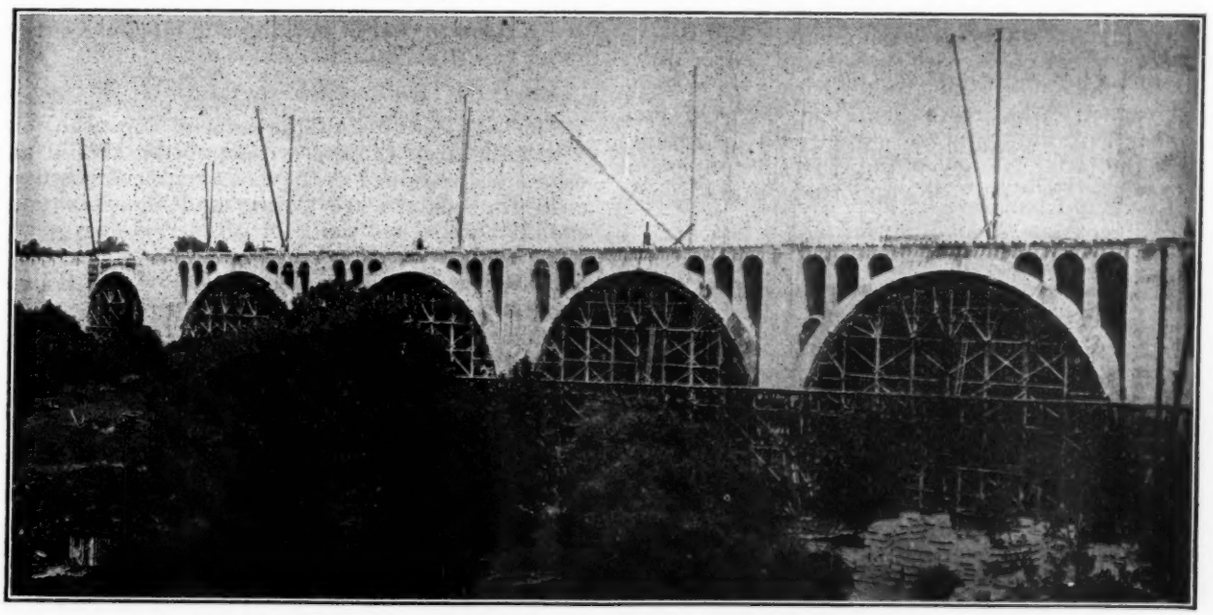
The arch center should support the entire span between skewbacks or between false skewbacks, and should act as a unit both in its function and when it is being removed. For very short spans it is generally made of wood and consists of a rigid framework with a horizontal lower member supported at the ends and, if necessary, at intermediate points. The upper member is curved to correspond with intrados of the arch and to support the lagging or transverse elements of the bottom of the form.

Generally the framework consists of several parallel ribs transverse to the axis of the arch and securely braced together by horizontal and diagonal members. For convenience in short spans the curved upper members of the centers are genrally made of three thicknesses of planks breaking joints, and spiked or bolted together to make segmental ribs, the upper edge of which is a continuous arc and the lower edge is formed of straight line chords to the arc. The extremities of the arc are usually connected by a horizontal bottom chord, which, if the span is more than 5 or 6 feet, is generally braced to the different segments of the top chords.

Centers of this type, properly designed, may themselves form trusses adequate to span openings of 15 or 20 feet in the clear and if the top chords are made of square timbers properly jointed and spliced and with a suitable system of bracing and tension rods the length of the span may be increased to 40 or 50 feet and require supports only at the extremities.

TRUSSED CENTERS

For spans of this length or greater it is, however, generally better to provide special inde-



CONNECTICUT AVENUE BRIDGE, WASHINGTON, D. C., ERECTED ON TRESTLE FALSEWORK ARCH CENTERS AND CONCRETED BY OVERHEAD DERRICK SYSTEM AND LOW LEVEL SERVICE TRACK.

pendent trusses or to make special centering trusses or to support comparatively light centering frames at the ends and at intermediate points. Special trusses may be made to serve as centers if their top chords conform to the curve of the arch soffit and are frequently made, especially for long spans, of riveted or pin connected structural steel members as carefully designed and fabricated as are permanent railroad bridges.

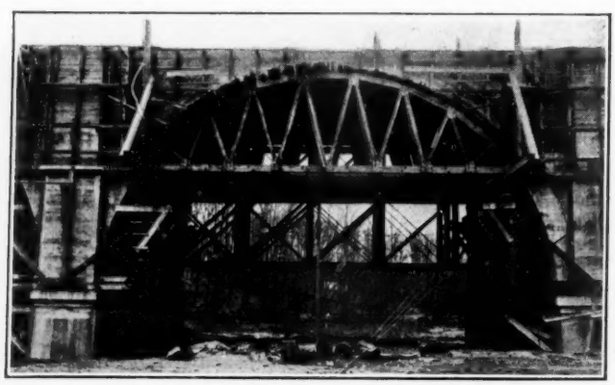
These generally receive the lagging directly on their top chords and are supported from the piers or on falsework bents adjacent to them. They are generally desirable where the elevation of the arch soffit above the ground is very great; where a wide, clear opening must be preserved for traffic or navigation; where the water is very deep or very swift or is subject to flood, heavy ice or drift; or where the bottom is very soft and treacherous or very hard and irregular, making it difficult to install falsework on it.

SUBDIVIDED SPANS

In such cases, however, it may be profitable to subdivide long spans into two or more shorter ones by the construction of temporary towers or supports intermediate between the piers. For this purpose one or more pairs of pile trestle bents securely braced together generally make the most convenient and economical pier where their use is practicable, but if the bottom is too hard to drive piles they may sometimes be replaced by timber cribs filled with stone and serving for a footing on which framed bents are erected to form the upper part of the tower.

PILE FALSEWORK SUPPORT

If the upper part of the arch soffit is not far above the surface of the ground or of the water, if no wide clearance spaces have to be maintained under it, and if there is no difficulty in installing and maintaining falsework in the water or on the ground, it may be more economical, especially for a single span, to support the arch centering on transverse trestle bents, each composed of two or more vertical posts with or without batter posts at the ends. On solid ground with a good bearing capacity, the trestle bents may be of framed timber with mud sills laid directly on the ground or if the latter is uneven and it is not convenient to level it they may be supported on low blocking or cribbing. If the ground is soft the sills may be laid on grillages of transverse timbers properly proportioned to distribute the load over a sufficiently large bearing area.



TRUSSED CENTER SUPPORTED ON FALSEWORK BENTS FOR NESHAMING BRIDGE

Framed trestle bents with mud sills may be also used on the river bed if the latter is flat and smooth, but are not suited to an irregular surface. If the water is deep or the bottom soft or irregular it will generally be necessary to support the centering on pile foundations and the piles may be cut off above water level and capped to support frame trestle bents, or if the height is not too great they may be carried up nearly to the intrados and support the centeding directly on their caps, parallel to the axis of the arch.

PILE DRIVING AND BRACING

Piles should be carefully proportioned to the load and to the bearing value of the bottom and should be well driven to satisfactory refusal by a drop hammer, steam or air hammer. Special care should be taken to X brace them thoroughly, both transversely and longitudinally without which they have little stability.

Where a large number of piles are used, unless they are very lightly loaded, they should be driven to a penetration of not more than 1 inch under the last blow of an ordinary 2,000-pound drop hammer falling 10 feet. If this is not possible, the bearing power of the pile should be carefully estimated by the use of any standard pile formula or by an actual loading test, and if any appreciable settlement occurs under double the maximum load that the piles will have to sustain in the construction of the bridge, additional piles should be added.

If this is impossible provision for settlement may be made by putting double caps on the piles and separating them by pairs of folding wedges that can be driven up to compensate for settlement. A better plan on important work is to arrange the double caps with sufficient space between them to permit packing and blocking of the upper cap if necessary.

PROVISION FOR SETTLEMENT

The sills parallel to the axis of the arch, on which the arch centers are supported should always be maintained at the exact required position until the centers are swung and the elevation should be checked daily or oftener if necessary, by careful levels taken on it and on a bench mark and any indicated settlement should be immediately met by operating the adjustments already described.

STRIKING CENTERS

The bearings of the arch centers or arch center trusses on their sills should be made adjustable with wedges, jack screws, or sand boxes arranged to be operated independently of the adjustment for the pile caps and so designed that when the concerte has properly set the centers can be quickly struck by operating the adjustments so as to lower the center uniformly and give it an under clearance from the arch soffit.

Sand boxes are very convenient and satisfactory devices, especially for very heavy spans. They

consist simply of a receptacle open on top and filled with dry sand, the level upper surface of which supports a plunger or pedestal with moderate clearance from the sides of the box, and bearing the bridge load on its upper end. The sand boxes must be protected from moisture, which may be accomplished by sealing them around the plunger and the upper end of the box.

When the arch center is to be struck, small holes are opened at the bottoms of the boxes and the sand is allowed to flow out or is removed by spoons or by small water jets, care being taken to measure the amount uniformly and simultaneously removed from the different sand boxes, stopping the operations by signals as soon as a given amount has been removed, and thus assuring perfect uniformity as the plungers settle to correspond with the removal of the sand.

SHIFTING ARCH CENTERS

If there are several duplicate spans the centering after being struck under the first span can be removed transversely, usually on rollers between it and its sills until it is free of the span and then is moved longitudinally opposite the next span, and transversely back into position on the supports there and used for its construction, and so on for succeeding spans. Centers of moderate lengths can be removed easily by hand, larger and heavier ones are generally removed as units by derricks, cableways or other convenient apparatus installed on the job, and if very large trusses are used they may sometimes be divided into semi-trusses and handled separately, but are generally handled singly or in braced pairs by the plant installed.

Ordinary bridge trusses may be utilized for supporting the centers if they are available. They can be supported on the abutments or on special falsework bents or towers and provided with adjustable bearings on their top chords to support the centering at the ends and intermediately if necessary.

Repairing Bituminous Macadam Highways by Cold Patch Method

The Second Division of the New York State Department of Highways, comprising the eight counties in the northeastern part of the state, contains about 915 miles of road paved with bituminous concrete, repairs on which aggregated during the year 1920 about 400,000 square yards of resurfacing by the cold patch method. The material used in this method consists of asphalt or tar, and stone of the smaller sizes, mainly ⅝-inch and 1½-inch.

The bituminous material is prepared by the manufacturers so that it is of such consistency as to be readily mixed cold with the stone. The mixing is done in small Yeager concrete mixing machines of 7 cubic feet capacity, that discharge two or three successive batches into underslung steel boxes of 20 cubic feet capacity suspended from pairs of wheels.

The tailboard is let down and the mixed material is discharged and spread with long-handle hoes and rakes, after which it is properly rolled, tamped and smoothed to the required finish and soon becomes hard and tough, providing satisfactory repairs that are much more cheaply and conveniently made than if an attempt were made to use hot materials.

The materials are mixed at some convenient place alongside the road and are hauled up to about a quarter of a mile, after which the mixer is moved to a new position. The average repair gang consists of about six men, including a foreman, three or four of the laborers being required to load and dump the mixer, and the remainder to haul the mixture and spread it on the road surface. Under ordinarily favorable conditions, when the work is not too much scattered, a gang will lay about 180 square yards of patches in an eight-hour day.

The amount of work done, of course, depends on the character of the work, such as the location and extent of the holes to be patched, and the average amount of work done in a day will vary more or less according to the conditions. Repair work is carried on in any except wet or freezing weather.

Patching bituminous macadam roads by the above method, using small concrete mixers for mixing the material was originated and developed several years ago in this division, which is under the supervision of Commissioner Herbert S. Sisson and Division Engineer Harvey O. Schermerhorn.

Many Building Operations

In the 27 northeastern states the building operations during the month of May, according to the F. W. Dodge Company's review, amounted to $242,093,000, showing an increase of 9½ per cent over April and about the same amount as in the month of May in 1919 and 1920, although the total amount of building in the same area from January 1, 1920, to June 1, 1920, was nearly $500,000,000 greater than that from January 1 to June 1, 1921.

In May, 1921, the increase in activity would have been greater except for the widespread labor troubles, especially in New England and the middle west. Residential building was 34 per cent, public works and utilities 27 per cent, business building 12 per cent, educational building 10 per cent and industrial building 8 per cent of the total. During the first five months of the year the total investment thus represented by the totaling of contracts let in that period amounts to $839,357,000, being 11 per cent ahead of the preceding five years. During the five months more than $2,000,000,000 of contemplated work has been reported.

To Bridge San Francisco Bay

It is reported that money has been subscribed for a bridge across San Francisco Bay, to cost $25,000,000. The bridge will be 8⅛ miles long, 200 feet wide, and besides providing for traffic of all kinds will carry oil, gas and water pipes and electric conduits for public utility companies. The plans for the structure have been completed and the terminals selected.

Paving Materials in Various Counties

Reports from hundreds of counties throughout the United States telling where contractors can obtain stone, gravel and sand that will be satisfactory to county engineers for use in concrete, macadam and gravel road construction.

(*Continued from Page 506*)

NEW YORK

Broome—A yes, B yes, D yes, E yes, G yes.
Cayuga—A yes, several, B yes, D yes, E yes, G doubtful, one gravel concrete was not a success.
Chenango—A yes, B bituminous macadam, D yes, E yes, G yes.
Franklin—A yes, B yes, D yes, E yes, G yes.
Jefferson—A one commercial, B 2 commercial, C local quarries in all parts, D yes, E yes, G yes.
Madison—A yes, B yes, E yes, G yes.
Monroe—A yes, B yes, D yes, E yes, G yes.
Nassau—A no, B no, C Tompkins Cove limestone, N. Y., D yes, E yes, F commercial gravel plants North Shore, L. I., G yes, H commercial gravel and sand banks, North Shore.
Niagara—A yes, B yes, C some imported, D no, E very little, G yes, H river sand used largely, 25 miles.
Orleans—A yes, B yes, D yes, E yes, G yes, by being washed.
Oswego—A yes, B yes, D yes, E yes, G yes.
Otsego—A yes, lime and sand stone, B yes, D yes, E yes, G yes.
Saratoga—A yes, B yes, D yes, E yes, G yes.
Yates—A yes, B yes, D yes, G yes.

NORTH CAROLINA

Beaufort—A no, B no, C 60 miles, D no, E no, F 125, G yes.
Buncombe—A yes, B yes, D yes, E yes, G yes.
Cherokee—A yes, B yes, D yes, E yes, G yes.
Craven—A no, B no, D no, G yes.
Durham—A yes, B yes, D no, E yes, G yes.
Lenoir—A no, B no, C 100 miles, D no, E no, F 50 miles, G yes, great quantity.
Mitchell—A yes, B yes, D no, E no.
Randolph—A yes, B yes, D yes, E yes, G yes.
Washington—A no, B no, C 100 miles, D no, E no, F 100 miles, G yes, plenty.
Watanga—A yes, B yes, D not in large quantities, E yes, G no, H must be shipped, except small quantities.
Wayne—A none, B none, C 50 miles, D gravel pits, yes, E yes, G yes.
Wilkes—A yes, B yes, D yes, E small amount, G yes.
Wilson—A yes, B yes, D yes, E yes, G yes.
Yancey—A yes, B yes, D yes, E yes, G yes.

NORTH DAKOTA

Barnes—A no, B no, C 300 miles, D yes, E yes, G yes.
Foster—D only a few, E some gravel, but far to haul, F 10 and 20 miles, G some sand but long haul.
Grand Forks—A no, B no, D yes, E yes, G yes.
Grant—A yes, with crusher, D yes, by screening, E yes, G yes.
Hettinger—A yes, B no, D yes, several, E yes, G yes.
McIntosh—D yes, E yes, G yes.
McKenzie—A no, D yes, E yes, G yes.
Mountrail—A no, B no, C plenty of loose rock, D yes, E yes, G yes.
Pembina—A no, C 200 miles, D yes, E yes, F 5 miles west of Cavalier, sand and gravel, G yes, ridge 1 mile wide and 10 miles long, only one in Pembina.
Pierce—A no, B no, D yes, E yes, G yes.
Ward—A no quarries, boulders can be crushed, B only boulders, C 400 miles, D yes, by screening, E yes, G yes.
Williams—A no, B no, D yes, E yes, G yes.

OHIO

Allen—A yes, B yes, D yes, E yes, G yes.
Ashtabula—A no, B no, C 50 to 60 miles, D very limited amount, E some, G lake sand.
Carroll—A no, B no, C 30 miles for slag, D yes, E yes, G yes.
Champaign—A Greenville Gravel Co., B none, C 50 miles, D yes, E yes, G yes.
Clark—A no, B yes, D yes, E yes, G yes.
Clermont—A yes, B yes, D yes, E yes, G yes.
Clinton—A yes, B yes, D no, E yes, F gravel is 40 miles distant, G yes.
Columbiana—A no, B foundation only, C 40 miles, D yes, Ohio river, E yes, Ohio river, G yes, Ohio river.
Coshocton—A grade A gravel, B some small limestone outcrops, C Marble Cliff, Columbia, 70 miles, 100 miles, D yes, E yes, G yes.
Darke—A no, B yes, D Ridgeville, Ind., 30 miles, D yes, E yes, G yes.
Erie—A yes, B yes, D no, E no, G sand taken from the lake is secured from local companies.
Fairfield—B no, C 30 miles, Columbia, Ohio, D yes, E yes, G yes.
Fayette—A ⅓ of area of county (south part) stone available for macadam roads and concrete, B same as A, D small part, northeast corner of county, also at Washington (central) if developed, G but little.
Fulton—A none, D if screened and worked, E yes, G none, H 100 miles.
Henry—A none, B none, C 35 miles, D none, E none, F 20 miles, G none, H lake sand 40 miles.
Highland—A yes, B yes, D yes, E yes, G yes.
Holmes—A no, B no, C about 100 miles, D yes, E yes, G yes.
Jefferson—A yes, B yes, D yes, G yes.
Licking—A no, B no, C 35 miles, D yes, E yes, G yes.
Marion—A yes, B yes, E yes, G yes.
Meigs—A limestone quarry, B limestone, E Ohio river, H Ohio river.
Ottawa—A yes, B yes, D no, G yes.
Pickaway—A yes, B yes, D yes, E yes, G yes.
Putnam—A yes, B yes, D yes, E yes, G no, H 50 miles.
Richland—A no, B no, C 60 miles, D no, E yes, G yes.
Ross—A yes, B yes, D many, E abundance, F throughout county, G many.
Sandusky—A yes, B yes, D no, E yes, G no.
Summit—A no, B no, C about 90 miles, D no, C yes, G yes.
Trumbull—A no, B no, D no, E yes, G no, H no.
Tuscarawas—A none, B slag plant at Doon, D yes, E yes, G yes.
Union—A yes, B yes, D yes, E yes, G yes.
Warren—A no, B no, C Loveland, Ohio, D yes, E yes, G yes.
Williams—A no, B no, C Holland, near Toledo, 40 miles, D yes, E limited to certain sections, F 30 miles, Indiana or Michigan, G yes, plenty.

OKLAHOMA

Beckham—A no, B yes, D yes, E yes, G yes.
Carter—A no, stone available but not convenient, C 30 miles, D yes, E yes, G yes.
Choctaw—A none open, B none open, D yes, E yes, G no, H 100 miles.
Craig—A yes, D no, G no, H some stone crushed and shipped in for concrete.
Dewey—A none, C not known, D yes, E yes, G yes.
Garfield—A no, B no, C 175 miles to a good one, D no, E no, F 175 miles, G yes.
Grady—A no, B no, C 40 miles, D no, E yes, G yes.
Hughes—A no, B none, C 100 miles, D no, E no, F 100 miles, G none, H 100 miles.
Kingfisher—A no, B no, C about 125 miles, D no, E no, G very few, H Arkansas river sand from Wichita, Kan., 200 miles.
Latimer and Leflore—A no, B no, C Hartshorn cement plant 18 miles from Wilburton, 60 miles Poteau, D yes, E yes, G Arkansas river, north line Leflore county.

Major—A little, C 28 miles, D no, F 28 miles, G very little, H 28 miles.
Oklahoma—A no, B no, C 100 miles, D no, E no, F 35 miles, G no, H 35 miles.
Pottawatomie—A Harjo gravel pit, B no, C 60 miles, D Harjo gravel pit, E Harjo gravel, G 3.

OREGON

Lake—A yes, B yes, D not without crushing, E yes, G very poor sand, H 30 miles.
Marion—A 10, B 10, D no, can be had at river, E yes, G no, can be had at river.
Morrow—A yes, B yes, D yes, E yes, G sand shipped from Umatilla station.
Multnomah—A yes, B yes, D yes, E yes, G yes.
Polk—A yes, B yes, D yes, E yes, G at Willamette river.
Sherman—A yes, B yes, D no, E yes, F 80 miles to Umatilla, G yes.
Washington—A none accessible, B 28, D none has been used, E one operated, G no, H ship in from various points.
Wheeler—A yes, B yes, D yes, E yes, G yes.
Yamhill—A several, B several, D gravel bars on river, E yes, G not very good sand, H Columbia river west 75 miles, Willamette run 50.

PENNSYLVANIA

Armstrong—A yes, B yes, D no, E no, G sand is dredged from Alleghany river.
Erie—A no, B no, D yes, E yes, G yes.
Mifflin—A yes, B yes, D no, E no, F unknown, G eys.
Monroe—A yes, B yes, D yes, E yes, G yes.
Potter—A none, B none, C not known, D no, E no, G no, H not known.
Susquehanna—A yes, B yes, D yes, E yes, G yes.
Warren—A no, B yes, D yes, E yes, G yes.
Wyoming—C 15, D yes, E plenty of them, G yes.

RHODE ISLAND

Bristol—A no, B no, C 9 miles, D yes, E yes, G yes.
Providence—A yes, B yes, D yes, E yes, G yes.

SOUTH CAROLINA

Greenwood—A yes, B yes, D no, E no, F 86 miles, G yes.

SOUTH DAKOTA

Beade—A no, B no, C about 60 miles, D few, E yes, G yes.
Clay—A no, C 80 miles, D yes, G yes.
Codington—D yes, E yes, G ves.
Corson—A no, D yes, E yes, F pits along center of county E & W pit run, G 35 per cent gravel, 65 per cent sand.
Custer—A yes, B yes, D yes, E yes, G yes.
Davison—A no, C about 2 miles east of county line, D yes, E yes, G yes.
Day—A no, field stone available, B no, C 60 miles, Ortonville, D yes, E yes, G yes.
Gregory—A yes, C Gregory and vicinity, D no, E no, G yes, Burke, Gregory, H. Herrick, St. Charles, Bonesteel.
Haakon—A none, B none, C 100 miles, D yes, E yes, G yes.
Hanson—A yes, B yes, D yes, E yes, G yes.
Jackson—A none, B none, C 100 miles, D yes, E yes, G yes.
Lincoln—A no, B no, C 25 miles, D yes, E yes, G yes.
McCook—A yes, B yes, D yes, E yes.
Miner—A unknown, C 30 miles, D great many, E yes, G yes.
Minnehaha—A yes, B yes, D yes, E yes, G yes.
Perkins—A no, B no, C 38 miles, D yes, E yes, G yes.
Spink—A no, B no, C 200 miles, D no, E small amount, F 82 miles, G no, H 82 miles.
Stanley—A no, B no, C 160 miles, D no, E yes, G yes.
Sully—A no, B no, D yes, E ves, G ves.
Tripp—A yes, B yes, E yes, G yes.
Union—A no, B no, C 70 miles, D yes, E yes, G yes.
Walworth—A no, B no, C 40 miles, D yes, E yes, G yes.
Yankton—A none, B yes, D yes, E yes, G yes.

TENNESSEE

Bedford, Coffee and Moore—A no, B yes, C 75 miles, D no, E yes, G no, H 75 miles.
Benton—A a number, B none, D plenty, E a number, G yes.
Cocke—A numerous, B numerous, D yes, E yes, G yes.
Greene—A yes, B yes, D no, E no.
Hamilton—A yes. B yes, D from Tennessee river, E yes, G from Tennessee river, H no bank sand.
Lewis—A creek gravel, C 50 miles, D creek and river gravel, G from river and creeks only.
Lincoln—A yes, B yes, D yes, E yes. G yes.
McMinn—A yes, B yes, D yes, E yes, G no, H Lenoir City, 25 miles.
Monroe—A yes, B yes, D no, E very little, G very little, H 75 miles.
Robertson—A yes, B yes, C 2 miles, D yes, F near all roads, G yes, H convenient.
Tipton and Lauderdale—A no, B no, C 150 miles, D no, E yes, F 100 miles, G river and sand near Covington.
White—A yes, B yes, C in county, D no, E no, F 28 miles, G yes, H in county.

TEXAS

Aransas—A no, B no, C 75 miles, D no, E no, F 75 miles, G no, H 75 miles.
Bosque—A yes, B yes, D yes, E yes, G yes.
Callahan—A none open but good locations, B same as A, D no gravel bank located as yet, E yes, G yes.
Cameron—A none, B no, D no, E no, F 100 miles, G no, H 300 miles.
Carson—A no, B no, C none near, D no, E no, F 5 miles, G yes.
Colorado—A yes, 3, B yes, 2, D yes, E yes, numerous, G yes.
Comanche—A yes, B yes, D yes, E yes, G yes.
Dickens—A yes, B yes, D yes, E yes, G yes.
Edwards—A no quarries, but plenty of stone, D very little gravel, G none, but small quantities of sand can be obtained from river beds. It will be necessary to use crushed stone screenings for sand.
Fort Bend—A no, B no, C none near, D yes, but not being worked, E same as concrete gravel, F present sources, Colorado county, G yes, but not worked, H present source, Colorado county.
Gonzales—A yes, D yes, E yes, G yes.
Harris—A no, B yes, C 125 miles, D no, E no, G no.
Hill—A no, B yes, D no, E yes, G no, H 60 miles.
Johnson—A not near enough transportation, B yes, but too yar from transportation, C about 75 miles, D only limited quantities, E yes, G none, H about 40 miles.
Limestone—A one, B one, D no, E no, F 75 miles, G no, E 75 miles.
Madison—A yes, B no, D no, F 40 miles, G yes.
Milam—A yes, B yes, D yes, E yes, G yes.
Montague—A none, B none, C 20 miles, D sand only, E yes, G yes.
Rockwall—A no, B no, C 100 miles, D no, E no, F 40 miles, G no.
San Augustine—A no, B no, E yes, G no.
Shackelford—A yes, B yes, D limited amount in beds of streams, E plentiful, G limited amount in beds of streams.
Tarrant—A no, B no, C 50 miles, D yes, E yes, G yes.
Trinity—A yes, B yes, D yes, E ves, G yes.
Wise—A 1 near Chico, B none, but banks, D none, but some ore used, E numerous, G yes.

VERMONT

Bennington—A yes, B yes, D yes, E yes, G yes.
Burlington—A yes, 2, B yes, D yes, E yes, G yes.
Orange—A yes, B yes, D yes, E yes, G yes.
Windham—A none developed, B none developed, C 30 miles, D yes, E yes, G yes.

VIRGINIA

Augusta—A yes, B yes, D no, E no, G no, H Meechums river, about 30 miles.
Brunswick—A 2, B 2, D none, E yes, G yes.
Campbell—A yes, 5, B yes, 5, D no, E no, F 100 miles, G sand in streams, very plentiful, H 100 miles.
Fairfax—A yes, northwest part, B yes, northwest part, D yes, a few, E yes, numerous, G yes, extreme southeast, H river sand and gravel at Washington or Alexandria.
Nansemond—A no, B no, C 200 miles, D yes, E yes, F 20 miles, G no.
Pittsylvania—A yes, one, B one, D no, E no.
Scott—A yes, B yes, D yes, E yes, G yes.

WASHINGTON

Adams—A yes, B yes, D yes, E yes, G no, H sand shipped 74 miles.
Benton—A yes, B yes, D yes, G yes.
Clallam—D yes, E yes, planty, G yes.
Clarke—A yes, B yes, D no, E yes, F concrete gravel in river, 25 miles, G no, H concrete sand in Columbia river, south boundary of county.
Grant—A yes, B yes, D yes, E yes, G yes.
Island—A no, B no, D yes, E yes, G yes.

Jefferson—A yes, but not in operation, B same as A, D yes, E yes, G yes.
Lincoln—A yes, D yes, E yes, G yes.
Okanogan—A yes, B yes, D yes, E yes, G yes.
Pacific—A none, B none, C 50 miles, D no, E yes, F 50 miles for concrete gravel, G no, H 50 miles.
Skamania—A yes, B yes, D yes, E yes, G yes.
Snohomish—A yes, B no, C 40 miles, D yes, E yes, G yes.
Wahkiakum—A not known, B plenty, D several places, G plenty in Columbia river.

WEST VIRGINIA

Boone—A yes, B none, D yes, E yes, G plenty.
Brooke—A in southern part of county, B same as A, D yes, E not used, G yes.
Cabell—A yes, B all sand stone, D yes, E yes, G yes.
Calhoun—Materials have not been tested sufficient to answer questions.
Hardy—A yes, B yes, D yes, E yes, G yes.
Mercer—A yes, B yes, D no, E no, F 40 miles, G no, H 40 miles.
Mineral—A yes, B yes, D yes, E yes, G yes.
Morgan—A yes, B yes, D no, E no, F don't know, G no, H generally get sand from Washington, D. C.
Nicholas—A no, B no, C 100 miles, D few local deposits in creek beds, G some river sand.
Ohio—A yes, B yes, D yes, Ohio River, E yes, G yes, river.
Pocahontas—A yes, B yes, D yes, E yes, G no, H 120 miles.
Randolph—A yes, B yes, D no, E no, F 175 miles, G no, H 175 miles.
Summers—A 2, B ves, C 30 miles, D no, E yes, F 1.5 miles, G no, H 30 to 50 miles.
Taylor—A hard sand stone, D no, F Ohio river 103 miles, G very small quantities, H Ohio river sand used mostly.
Wayne—A not very satisfactory, B only fair, C reasonably close, D none. E none, F imported, G Pole creek sand is chief supply, H best to import material.
Webster—A no, B no, C 15 miles, D yes, E yes, G yes.
Wetzel—A yes, B no, D yes, E yes, G yes.

WISCONSIN

Adams—A no, B no, C 30 miles, D yes, but 8 miles from R. R., E same range of banks, G no, H 45 miles.
Bayfield—A one, B one, D yes, E yes, G yes.
Buffalo—A yes, 2, B ves, 2, D one, E one, G yes.
Calumet—A yes, 2, B yes, 2, D no, E 5, G no, H 18 miles.
Dunn—A yes, B yes, D yes, E yes, G yes.
Forest—A yes, B yes, D yes, E yes, G yes.
Grant—A yes, B yes, D no, G yes.
Iron—A no, B no, D yes, E yes, G yes.
Jefferson—A yes, B yes, D no, E yes, G yes.
Juneau—A yes, B yes, D no, E yes, F 30 miles, G yes, H 3 or 4 miles.
LaCrosse—A yes, B yes, D no, E no, G yes, H less than ¼ mile from railway.
LaFayette—A yes, B yes, C 75 miles, D no, E no, but tailings, G tailings.
Lincoln—A yes, lots of them, D yes, E yes, G yes.
Portage—A no, B field rock, D yes, E yes, G ves, H several pits within a mile of rock.
Sauk—A yes, B yes, D yes, E yes, G yes.
Trempealeau—A yes, B yes, D no, E yes, G yes.
Vernon—A yes, B yes, D no, E no, F Winona, Minn., G yes.
Waushara—A yes, red granite, B yes, D yes, E yes, G yes.

WYOMING

Natrona—A yes, D yes, E yes, G yes.
Weston—A no, B no, C Edgemont, river gravel, D yes, Cheyenne river, E no, G yes, same place, H Edgemont, S. D.

Economy by Kansas Highway Commission

Under date of June 3 the Kansas Highway Commission sends a notice to engineers and contractors working for or in connection with it that on account of reduced appropriation certain economies in both expenditure and work performed will be put in effect at once. Among other improvements, no telegraph messages will be received except where charges are prepaid by the sender and "it will be necessary that we refrain from the use of long distance telephone or telegraph service except in emergencies." Also because, we presume, of a compulsory reduction of the force, subjects brought before the commission in any way will be considered in the order of their importance, which order it states as follows. 1—Federal Aid Construction. 2—Federal Aid Plans. 3—State Aid Construction. 4—State Aid Plans. 5—Original County Bridge Plans. 6—Railroad Grade Crossing Elimination and Protection. 7—Original County Road Plans. 8—Federal Equipment. 9—Changes in County Road System. 10—Alternate Bridge Plans. 11—General inquiries and miscellaneous matters.

Duplex Concrete Highway

About 2,000 lineal feet of duplex concrete pavement was laid last year by the departmental forces near the southern line of Rensselaer county, in the Second Division, New York State Department of Highways, under the design and supervision of Harvey O. Schermerhorn, division engineer.

This roadway has two 9-foot strips of concrete, 7 inches thick, reinforced by steel mesh weighing 25 pounds to the square yard, and separated by a 6 feet wide strip of bituminous macadam.

It was built at a cost of about $50,000 per mile at the peak of post-war prices. Since then prices on materials and labor have been reduced considerably and the cost per mile for this type of road if built this year would be decidedly less.

The materials were delivered by trucks and dumped in small piles along the subgrade and then handled by wheelbarrows, the work being done in the usual manner, with standard equipment.

Results have so far been considered very satisfactory, justifying all expectations of an extensive use of the same type of roadway in the future. From a construction standpoint the advantages of this duplex pavement over a single type pavement are, the ease with which it is built in separate longitudinal portions, allowing one side of the road to be under construction while traffic on the opposite side is unimpeded; and permitting old roads to be rebuilt without interruption to

From a traffic standpoint on the completed road traffic or provision for detours.
it is an ideal pavement, as the traffic in opposite directions is automatically divided and kept well separated by the distinctive colors of the pavement, the black asphalt in the center setting off in sharp contrast the white concrete on either side.

There is always room between the lines of vehicles for the faster moving ones to pass in front of the slower ones by turning out to the center of the roadway and running over the bituminous macadam, the latter therefore receiving very much less travel than the concrete, is able to stand up well under it, assuring a hard, satisfactory surface equal to all requirements and at a decidedly less cost than the all-concrete pavement.

At night the contrasting colors of the concrete and the bituminous macadam is so great that the two concrete tracks are sharply defined and more easily seen in the dark, thus assisting drivers to keep to the track, almost obviating danger of head-on collisions.

Recent Legal Decisions

DISPOSAL PLANT FOR PORTION OF CITY SEWAGE HELD LOCAL, NOT PUBLIC IMPROVEMENT FOR ASSESSMENT PURPOSES

In holding a disposal plant for a portion of city sewerage to be a local and not a public improvement, and therefore to be paid by private assessment, the Illinois Supreme Court, City of Elmhurst v. Rohmeyer, 130 N. E. 761, took into consideration the fact that the city had previously constructed a similar system of sewers connected with a disposal plant in another district of the city, and the property owners in that district paid for the disposal plant as a local improvement by special assessment. It would therefore be unjust now to call upon the property owners of the first district to contribute to the payment of this second disposal plant after having already paid for their own in their district.

The test whether or not an improvement is local depends upon the question whether or not it specially benefits the property that is specially assessed. Northwestern University v. Village of Wilmette, 230 Ill. 80, 82 N. E. 615. An improvement may be local, though of some general benefit to the public, if it also specially benefits the property assessed. Loeffler v. City of Chicago, 246 Ill. 43, 92 N. E. 586, 20 Ann. Cas. 335. Constructing a reservoir, digging a well, erecting a standpipe and pumping works and building for the same, with a view of constructing water works in a city, when of general utility to its inhabitants, are regarded as a public improvement to be paid for by general taxation, Ewart v. Village of Western Springs, 180 Ill. 318, 54 N. E. 478; but where structures are not of general utility to all the inhabitants of the municipality, but are only used for the benefit of a small part thereof, they are to be regarded as a local improvement. Fisher v. City of Chicago, 213 Ill. 268, 72 N. E. 680.

WATER COMPANY HELD LIABLE TO PARTY INJURED UNDER INDIANA STATUTE FOR INJURY BY DEFECTIVE FIRE HYDRANT

The Indiana Supreme Court holds, Trustees of J. D. Mem. M. C. Church v. New Albany Water Works, 130 N. W. 827, that a water company which, after agreeing in its contract with the city to keep fire hydrants in repair and furnish sufficient water to put out fires, surrendered its franchise for an indeterminate permit, was liable to a church under the Indiana Public Service Act, pars. 7 and 116, for loss by fire occasioned by the defective condition of a hydrant which the company negligently failed to keep in proper order; the liability in favor of the party injured being created by the provision in the latter section that: "If any public utility . . . shall omit to do any act, matter or thing required to be done by this act such public service utility shall be liable to the person, firm, or corporation injured thereby in the amount of damages sustained in consequence of such violation."

STATE AND TOWNS HELD NOT NEGLIGENT IN FAILING TO ERECT BARRIERS ALONGSIDE HIGHWAY

The New York Court of Claims holds, Best v. State, 186 N. Y. Supp. 359, that the state was not liable, under section 176 of the Highway Law and the amendments thereto, for the failure to erect barriers on an embankment at the side of a perfectly straight roadway, 22 feet wide and substantially level with the lands adjoining on one side, the embankment measuring about 12 feet at the deepest point on the other side. The state was therefore not liable for the death of a passenger in an autobus when the steering gear of the bus broke and the bus was deflected by one of the wheels striking loose gravel placed by the state alongside the macadam road bed, resulting in its falling over the embankment. The court said that if this action had been against a town, the town, under the authorities, would not be liable, because the town or its commissioner could not reasonably be held to anticipate such an emergency; and the state could only be held liable where the same state of facts would make a town liable for defects in its highway.

There are many authorities in the state of New York which hold, where the conditions are similar to those in this case, and where an emergency occurred which caused an accident, that such condition was not a defect, and it was further held that it was not negligence on the part of its commissioners to fail to erect barriers at such places. It has recently been decided by the Appellate Division, Third Department, where the circumstances were the same as in this case, where the plaintiff was driving an automobile truck upon an improved macadam highway, smooth and level for 20 feet in width, and the automobile locked wheels with a passing buggy, and in doing so the automobile turned at right angles to the road and went head over the embankment, that the commissioner of highways was not negligent in failing to erect barriers at a location of this kind; and it was further held that he was under no duty to anticipate such an emergency. Dorrer v. Town of Callicoon, 183 App. Div. 186, 170 N. Y. Supp. 676.

PAVING OF RAILROAD CROSSING BY RAILROADS

The Minnesota Supreme Court holds, State ex rel. City of Fairmont v. Chicago, St. P., M. & O. Ry. Co., 180 N. W. 295, that when the public welfare, convenience or safety requires a city street crossing a railroad right of way to be paved, and the city council so determines, the city may in the exercise of its police power compel the railroad to pave the crossing at its own cost. It is not enough that a foundation for a roadway is furnished. The police power of the municipality goes to the extent of compelling the railroad to maintain a surface thereon suitable for convenient travel. Of course the police power with reference to this subject, as well as to others coming within its application, may not be exercised arbitrarily or oppressively.

NEWS OF THE SOCIETIES

June 20—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Salt Lake City.

June 20-24—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 13th semi-annual meeting. Detroit, Mich.

June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

June 21-22—LEAGUE OF TEXAS MUNICIPALITIES. Annual Convention. Wichita Falls, Texas. Secy., Frank M. Stewart, University of Texas, Austin.

June 21-24—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint annual and Pacific Coast convention. Salt Lake City, Utah.

June 28 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

June 28-July 1 — SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, UNIVERSITY OF PITTSBURG. Annual convention, New Haven, Conn.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS. Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Treont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

CONFERENCE OF STATE SANITARY YENGINEERS

The Conference of State Sanitary Engineers, which was tentatively formed at New Orleans in 1919 and which met in Washington in 1920, perfected its organization by the adoption of a constitution at Boston recently. Officers were elected for the ensuing year. They are: chairman, C. A. Emerson, Jr.; vice-president, W. H. Dittoe; secretary-treasurer, Theodore Horton.

At this Boston meeting there was a very interesting program of committee reports and papers and active discussions on water supply, sewage disposal, mosquito control, and other lines of work conducted by the state and federal health departments. Noteworthy papers were "State Sanitation" by Prof. George C. Whipple of Harvard University, and "The Typhoid Epidemic at Salem, Ohio," by W. H. Dittoe.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The June outing of the Association will be held at Wardhurst, Lake Suntaug, Lynnfield, Mass., Wednesday, June 22, 1921. Meeting of the Executive Committee and business meeting of the Association will be held during the day.

Dinner served at 1 o'clock. Trains leave Boston (North Station) 9:45; 10:25 and 11:00 A.M., Eastern Standard Time, for Lynn, Mass. Busses leave Lynn (Central Square) 10:30 and 11:35 A.M., Daylight Saving Time, for Lynnfield. Train leaves Boston for Lynnfield at 10:15 A.M., returning leave Lynnfield at 5:07, Eastern Standard Time. The 1921 Annual Convention of the Association will be held at Bridgeport, Conn., September 13 to 16, inc. Headquarters at Stratfield Hotel. Charles W. Sherman, president; Frank J. Gifford, secretary; Frank Emerson, Edward M. Shedd, Richard N. Ellis, committee June outing.

AMERICAN ASSOCIATION OF ENGINEERS

Counting and tabulating 25,000 letter ballots for candidates in the national election of officers of the American Association of Engineers would require a force of 20 men working 3 days in two shifts if done by hand. This work was accomplished by use of a letter ballot of special card type and a tabulating machine. As fast as the ballots were received they were taken out of the envelope by the tellers, counted as to number and sent to the punching machine, where a hole was punched in the ballot to indicate each man's choice. The ballot then passed through a verifying machine which did not punch any holes but in case the punching was wrong an electrical alarm was given. There are three independent checks on the accuracy of counting in this tabulating machine.

PERSONALS

True, Albert O., has been retained as resident engineer on the construction of a reservoir and filter plant for the town of Wauseon, Ohio.

Mylchreest, J. Warren, has been appointed city engineer of Middletown, Ohio.

Bright, J. S., formerly district engineer for the U. S. Bureau of Public Roads at Denver, Colorado, has been transferred to San Francisco.

Parke, R. W., has been appointed construction engineer for the new seventh district, North Carolina State Highway Commission, with headquarters at Elkin, N. C. S. C. Currier is now district engineer, and U. L. Fisher maintenance engineer for the same district.

McComb, Major D. Q., is now chief engineer of the Tennessee Highway Department.

Bechthold, W. A., formerly assistant county highway commissioner of Racine county, Wisconsin, has been appointed county highway commissioner of that county.

Braunworth, P. S., of Newark, N. J., has been appointed manager of the water plant of Garfield, N. J.

Dryden, F. H., has been appointed city engineer of Salisbury, Md.

Hutchins, M. C., has been reappointed city engineer of Charlotte, N. C.

Sachs, William, has been appointed borough engineer of West Hazleton, Pennsylvania.

Schneider, Delmont J., has been appointed city engineer and street commissioner of Pocatello, Idaho.

Harrington, W. H., engineer of the West Side Irrigation District, has been appointed city engineer of Tracy, California.

Belk, Claude E., has been appointed city manager and purchasing agent of Houston, Texas.

Stinchfield, M. J., Jr., of Valparaiso, Ind., has been appointed assistant state engineer.

Bibbins, James Rowland, has resigned as supervising engineer of the Arnold Co. to become manager of the Department of Commerce and Communication of the United States Chamber of Commerce at Washington, D. C.

Ingemanson, Thure W., has been appointed resident engineer on paving work at Nora Springs, Iowa.

Bailey, H. G., has been engaged as highway engineer of Henderson county, N. C.

Fik, John B., has been appointed city engineer of Muskegon, Mich.

Houston, G. N., formerly acting commissioner of irrigation in the reclamation branch, Department of the Interior, Canada, has accepted a position as head of the provincial irrigation work with the Alberta government.

McKee, J. B., has been appointed city engineer of Plattsmouth, Neb.

Shriver, Clarence E., formerly special engineer with the Tallassee Power Co., Badin, N. C., in connection with street layouts on sidewalk and drainage work, water filtration, sewage disposal plants and systems, is now with the Kentucky State Highway Department.

Schultz, Charles, has been appointed city engineer of McKinney, Texas.

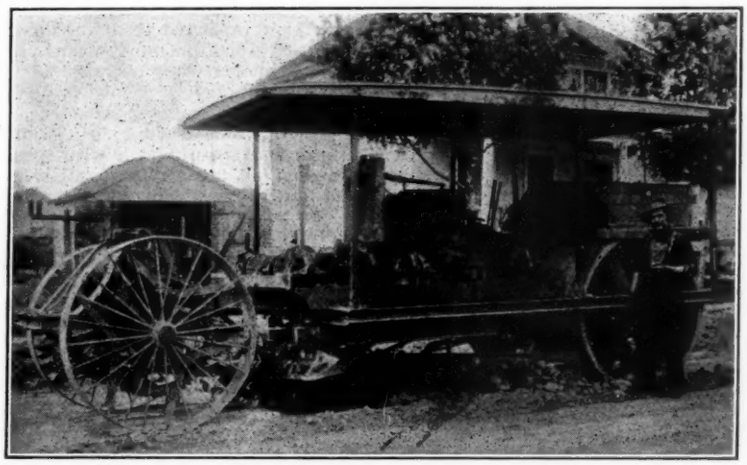
Dwyer, William J., has been appointed county superintendent of highways of Cortland county, N. Y.

Kurtz, John A., of Kansas City, Mo., has been reappointed member of the State Public Service Commission.

Rose, David, has resigned as county engineer of Koochicking county, Minnesota, to become district engineer of the State Highway Commission at Bemedji. His successor is A. B. Peterson, of Ericksburg.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



TRIPLE ACTION ROAD BUILDER MACHINE MAKING NEW GRADE ON CLAY AND STONE ROAD

OSWALD ROAD BUILDER

The Oswald triple action road builder, manufactured by the American Road Machinery Co., is designed to scarify and pulverize the hardest kind of macadam. It is a powerful, 13-ton, 4-wheel drive machine operated by a Liberty continental governed 4-cylinder, 45 h. p. motor, making 4,000 R. P. M. and equipped with an impulse starter, centrifugal cooling pumps, oil forced feed and splash oil system, and has a hollow crank.

The reversible grading blade is 18 inches wide and can be made up to 12 feet in length. The cast steel scarifier cuts a swath 7 feet 5 inches long and has 18 teeth 19 inches long that are held in place without bolts and can be changed in 10 seconds.

The normal compression of 240 pounds per square inch on the rear rolls can be increased to 300 pounds by filling them with water. The scarifier and blade are operated by a mechanical oil pump. The machine is 22 feet long, 8 feet 3 inches wide and 9 feet high and has a wheel base of 16 feet. The machine is operated easily by one man and has covered 3 miles of badly rutted and worn macadam road, putting it in good shape in 8 hours with a consumption of 2 gallons of gasoline per hour. It has a forward speed of 2 miles or of 4 miles per hour and a reverse speed of 2 miles per hour.

SULLIVAN DRILL SHARPENER

Drill sharpeners for hammer forging drill bits and shanks are made by the Sullivan Machinery Co. and described in bulletin 72-E. They are built in two sizes and consist of a clamp or vise, an upsetting hammer and a swaging hammer mounted on one compact frame. Their use is advantageous on account of the facility with which the work is done so preventing loss of time to machine and operator, to the labor economy which enables one smith and helper to handle as much steel as several hand crews, and to the uniformity which insures perfection in shape of all bits and accuracy of their dimensions.

The gradual hammer action preserves the quality of the steel and increases the strength and toughness, while the low forging heat enables the highest carbon steel to be handled without danger of burning. New bits can be made from bar stock in one minute or less; ordinary dull bits can be resharpened at the rate of 100 to 140 per hour.

The machines are adaptable to a considerable variety of work such as forging hammer heads and small tools and making bolts. The vertical member of the class A sharpener forms a light forge hammer for general utility. Bits made by the Sullivan air hammer process cut faster and farther and loose their edge and gauge less rapidly than bits made and sharpened by other methods.

The temperatures required for proper handling of steel in this machine range from 1,500 to 1,750 degrees Fahrenheit. The Sullivan drill steel furnace has been designed especially to secure more uniform heat for the drills to be sharpened.

The drill sharpener is built around two hammers and a compressed air vise, occupies a floor area of 5x2½ feet and 6 feet high, and weighs 4,000 pounds. The vise is operated at a pressure of more than 100,000 pounds and the hammers are under perfect control, being able to strike a single blow or many blows in succession and either light or heavy increments at will. Shanks can be made in one heat when only swaging or upsetting are required and in two heats when both swaging and upsetting are necessary. When ordered, the machines are equipped with a small pneumatic punch to open the holes in the hollow steels.

All the working parts are easily accessible and dolleys and dies can be quickly changed. The machines are operated with compressed air at 80 to 100 pounds pressure and consume only a small quantity of it.

Light drill sharpeners, class B, are designed and built to fill the demand for machinery adapted for forge hammer drill bits and shanks. It occupies a 4x2½-foot floor space, is 5 feet high, and weighs 1,500 pounds. It is suitable for steels 1¼ inches in diameter or less, for 2½-inch bits.

EVINRUDE UNIT CENTRIFUGAL PUMPS

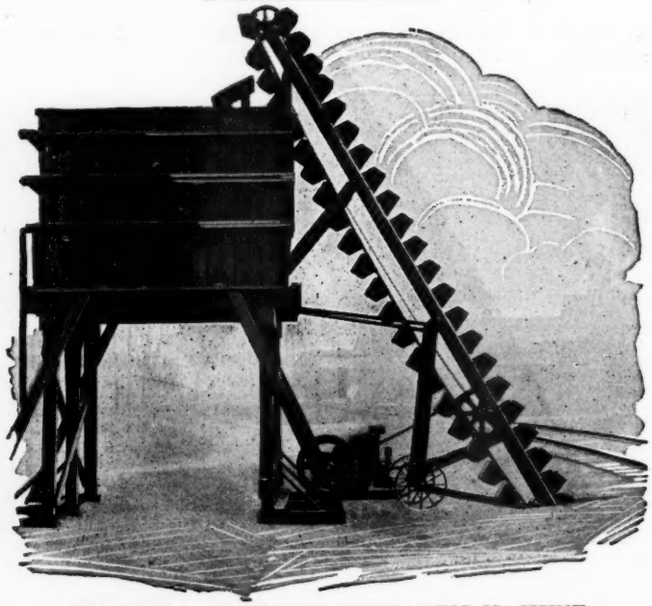
Unit centrifugal pumps made by the Evinrude Motor Co., consist of two main parts, the pump proper and the motor, which constitute a single unit complete in itself without gears, belts or chains.

Ignition is furnished by the Evinrude magneto built into the fly wheel and insulated and protected so that it cannot be in anyway damaged or put out of commission by dampness, or even by a drenching rain. It is provided with an extra large strainer that prevents the clogging of circulation waters and has a universal joint connecting the drive shaft.

The floor space required is only 19½ x 19½ inches, and its weight is only 115 pounds. The parts are few, the construction is rugged and it can be easily operated by an intelligent boy. It is made in two sizes, of 2 H.P. and 3½ H.P., with capacities of 2,000 gallons lifted 35 feet per hour and 1500 gallons to 45 feet per hour respective-

EVINRUDE UNIT CENTRIFUGAL PUMP

ly. For a lift of only 5 feet the corresponding capacities are 6 500 and 8,800 gallons per hour. When practical it is advised to submerge the pump, thus obviating the necessity of a suction pipe or priming.



FAIRFIELD PORTABLE UNLOADING MACHINE

STERLING ENGINES FOR EMERGENCY PUMPING

High powered Sterling gasoline engines up to 300 h. p. can be furnished for $16 to $30 per h. p. and are strongly recommended as auxiliaries to steam and hydro-electric power plants to insure service during breakdowns or other emergencies. They are self-contained units, instantly ready when started to assume full load, are easily operated, occupy very little space, have a low maintenance cost, can operate at centrifugal pump or generator speed. Are made with 4, 6 or 8 cylinders, intended to operate at 800 to 1,500 r. p. m. They are described in a circular issued by the Sterling Engine Company, Buffalo, N. Y., which illustrates their application to a number of city water works plants, where single machines discharge up to 3,000,000 gallons daily, up to total heads of 125 pounds.

FAIRFIELD CAR UNLOADER

The Fairfield portable car unloader and storage bin, manufactured by the Fairfield Engineering Company, is adapted for unloading, storing and loading sand, gravel, crushed stone or coal. The regular equipment consists of an eight horsepower kerosene engine with roller chain attached to a bucket elevator, provided with a two-wheel steel truck and discharging into a 30-ton elevated hopper bottom wooden storage bin supported on trestles with clearance for an automobile truck to drive under and be loaded by gravity through two sliding plate valves. The elevator is supplied through a track feeder which consists of a steel transverse trough installed below the rails and delivering the dumped material to the foot of the elevator. The bin is of sectional construction and the whole equipment can be installed and removed under ordinary conditions for $50. With it one man can unload 30 to 40 tons of material in 1½ hours, taking the place of a large gang of men and saving $8 or $9 in labor on every 50-ton car unloaded, beside reducing the idle time of trucks in service distributing material from the bin.

WHEEL TYPE OF P & H EXCAVATOR

This machine, manufactured by the Pawling & Harnischfeger Co., and described in bulletin IX, was designed for use on rough roads, with a narrow width, so as to occupy only a portion of the right of way, to use convenient fuel accessible readily in isolated spots, and to be so well constructed as to avoid breaking and be able to maintain a high rate of speed when working under favorable conditions. It is interchangeable so as to run on either side of the street, can throw the spoil to one side leaving the other side clear for traffic and is operated economically.

The engine is mounted on a steel truck with caterpillar traction in front under the foot of the vertical frame having an adjustable double boom containing the digging wheel and raising or lowering it into the ditch as required.

The trench is excavated full width and depth at a single progressive operation by buckets on the periphery of the digging wheel that automatically discharge into a transverse steel slot conveyor, depositing the soil alongside the trench. The selective transmission permits three instantaneous changes by a gear shifting lever, besides the changes obtainable by changing sprockets. Between February 1 and October 5, 1917, one of the machines excavated 4 miles of 6 and 12-inch water main trenches in wooded or frozen ground with shale at the bottom, for the water department of Erie, Pa. In gravel, which required sheeting, 1,620 feet of trench were excavated for a labor and fuel cost of 8.2 cents per foot as compared with a cost of 36.08 cents for hand work and backfilling.

Another machine excavated a daily average of 832 linear feet of telephone trench at a cost of $68.03, including fixed and overhead expenses, where it was estimated that hand labor for the same work would have cost from 25 to 30 cents per linear foot on the same wage scale.

AIR PUMPING

Air pumps manufactured by the Harris Air Pump Co., are specially designed and arranged for high efficiency, have no valves or moving parts, have smooth, unobstructed entrance and discharge openings combined with patented venturi mixing chamber, are compactly constructed of jointless bronze and are provided with specially designed arrangements to allow scale and dirt to pass out of the air line.

The booster pump operates automatically to deliver or elevate a fluid any required distance without additional air. Pumps have low operating and maintenance cost and have an unlimited height of lift, the pump has two cylinders side by side, provided with an automatic switch which allows the water to enter one cylinder by gravity while it is expelled from the other by air pressure, then reverses the process and so on. An single valve in the discharge line governs the quantity of discharge. The pumps are recommended for municipalities, for contractors and for use in driven wells and may be adopted to deep wells if necessary submergence is not obtained and specially designed tanks are used in the wells.

WANTED—Contractor or Builder to form partnership or association on some profitable work. Address Responsible, care Public Works.

INDUSTRIAL NOTES

The purchase of the Aetna Explosives Company's properties, assets and business by the Hercules Powder Company has been sanctioned by the Aetna stockholders. By this purchase the Hercules Company will acquire high explosives, or dynamite, plants near Birmingham, Ala., Emporium, Pa., Sinnamahoning, Pa., Ishpeming, Mich., and Fayville, Ill., two black blasting powder plants, one at Goes Station, Ohio, and the other near Birmingham, Ala., a plant for the manufacture of blasting caps and electric blasting caps at Port Ewen, N. Y., and a plant for the manufacture of fulminate of mercury, for use in blasting caps, at Prescott, Ontario, Canada.

With the Aetna Company's business, the Hercules Powder Company becomes a much larger factor in the explosive business of the United States, is now in a position to compete for business in all parts of the United States, and will be greatly strengthened in important fields which have hitherto been closed to it on account of freight rates.

HELTZEL PLANT PRODUCTION UNINTERRUPTED BY FIRE

The plant of the Heltzel Steel Form & Iron Company, Warren, Ohio, was partly destroyed by fire on Thursday, June 2.

The steel fabricating department suffered mostly from the damage—shipments of steel forms having been made a short time after the fire. This department has continued operation almost uninterruptedly since the fire.